DEVELOPING A STATE WATER PLAN

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1977

by

E. L. Bolke and others

United States Geological Survey

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CONTENTS

ILLUSTRATIONS

TABLES

ENGLISH-TO-METRIC CONVERSION FACTORS

Most numbers are given in this report in English units followed by metric units in parentheses. The conversion factors used are shown to four significant figures. However, in the text the metric equivalents are shown only to the number of significant figures consistent with the accuracy of the number in English units.

English Units (Multiply)	Abbreviation	(by)	Metric Units (To obtain)	Abbreviation
Acre-feet	acre-ft	0.001233	Cubic hectometers	hm^3
Feet	ft	.3048	Meters	m
Inches	in.	25.40	Millimeters	mm
Miles	mi	1.609	Kilometers	km
Square miles	mi^2	2.590	Square kilometers	km^2

Chemical concentration is given only in metric units--milligrams per liter (mg/L). For concentrations less than 7,000 mg/L, the numerical value is about the same as for concentrations in the English unit, parts per million.

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INTRODUCTION

This report is the fourteenth in a series of annual reports that describe ground-water conditions in Utah. Reports in the series, prepared cooperatively by the U.S. Geological Survey and the Utah Division of Water Resources, provide data to enable interested parties to keep abreast of changing ground-water conditions.

This report, like the others (see references, p. 16), contains information on well construction, ground-water withdrawals, water-level changes, and related changes in precipitation and streamflow. Supplementary data such as graphs showing chemical quality of water and maps showing water-table configuration are included in reports of this series only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

The report includes individual discussions of selected major areas of ground-water withdrawal in the State for the calendar year 1976. Water-level fluctuations, however, are described for the period spring 1976 to spring 1977. Much of the data used in the report were collected by the Geological Survey in cooperation with the Division of Water Rights, Utah Department of Natural Resources.

The following reports dealing with ground water in the State were released by the Geological Survey during 1976:

Seepage study of canals in Beaver Valley, Beaver County, Utah, by R. W. Cruff and R. W. Mower, Utah Department of Natural Resources Technical Publication 52.

Characteristics of aquifers in the northern Uinta Basin area, Utah and Colorado, by J. W. Hood, Utah Department of Natural Resources Technical Publication 53 (in press).

Hydrologic evaluation of Ashley Valley, northern Uinta Basin area, Utah, by J. W. Hood, Utah Department of Natural Resources Technical Publication 54 (in press).

Hydrologic reconnaissance of the Tule Valley drainage basin, Juab and Millard Counties, Utah, by J. C. Stephens, Utah Department of Natural Resources Technical Publication 56 (in press).

General chemical quality of ground water in the Kaiparowits coal-basin area, Utah, by Don Price, U.S. Geological Survey Miscellaneous Investigations Map I-1033-A (in press).

General availability of ground water in the Kaiparowits coal-basin area, Utah, by Don Price, U.S. Geological Survey Miscellaneous Investigations Map I-1033-B (in press).

Fracturing and subsidence of the land surface caused by the withdrawal of ground water in the Milford area, Utah, by R. M. Cordova and R. W. Mower, U.S. Geological Survey Journal of Research, v. 4, no. 5, Sept.-Oct. 1976, p. 505-510.

Water-resources investigations of the U.S. Geological Survey in selected coal-energy areas of Utah, by K. M. Waddell, U.S. Geological Survey Open-File Report.

Water resources of Dinosaur National Monument, Utah and Colorado, by C. T. Sumsion, U.S. Geological Survey Open-File Report 76-580.

Hydrologic studies by the U.S. Geological Survey in oil-shale areas of Colorado, Utah, and Wyoming, U.S. Geological Survey Open-File Report.

Selected hydrologic data, Uinta Basin area, Utah and Colorado, by J. W. Hood, J. C. Mundorff, and Don Price, U.S. Geological Survey Open-File Report (duplicated as Utah Basic-Data Release 26).

UTAH'S GROUND-WATER RESERVOIRS

Small quantities of ground water can be obtained from wells throughout much of Utah, but large supplies that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The major areas of ground-water development discussed in this report are shown in figure 1 and named in table 1. Only a few wells outside of these areas yield large supplies of water of good chemical quality for the uses listed above.

About 2 percent of the wells in Utah obtain water from consolidated rocks. The consolidated rocks that yield the most water are lava flows, such as basalt, which contain interconnected vesicular openings or fractures; limestone, which contains fractures or other openings enlarged by solution, and sandstone, which contains interconnected openings between the grains that form the rock and may also contain open fractures. Most of the wells that tap consolidated rocks are in the eastern and southern parts of the State in areas where water supplies cannot be obtained readily from unconsolidated rocks.

About 98 percent of the wells in Utah draw water from unconsolidated rocks. These rocks may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these sizes. Wells obtain the largest yields from the coarser materials that are sorted into deposits of uniform grain size. Most wells that tap unconsolidated rocks are in large intermountain basins, which have been partly filled with debris from the adjacent mountains.

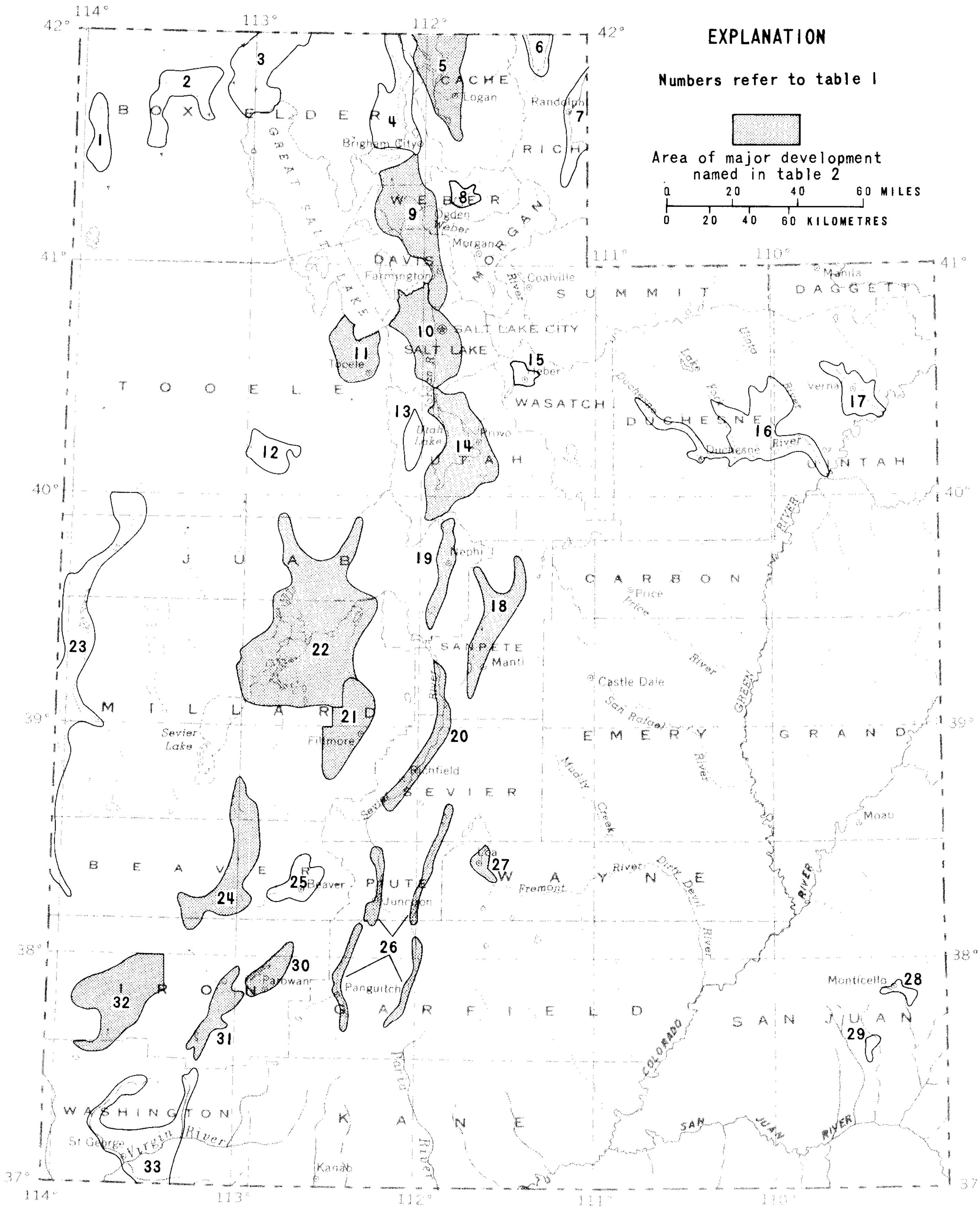

Figure 1.—Areas of ground-water development specifically referred to in this report.

Table 1.--Areas of ground-water development specifically referred to in this report

(Locations are shown in fig. 1)

	Area	Principal type of water-bearing rocks
1.	Grouse Creek valley	Unconsolidated
2.	Park Valley	Do.
3.	Curlew Valley	Unconsolidated and consolidated
4.	Malad-lower Bear River valley	Unconsolidated
5.	Cache Valley	Do.
6.	Bear Lake valley	Do.
7.	Upper Bear River valley	Do.
8.	Ogden Valley	Do.
9.	East Shore area	Do.
10.	Jordan Valley	Do.
11.	Tooele Valley	Do.
12.	Dugway area	Do.
13.	Cedar Valley	Do.
14.	Utah and Goshen Valleys	Do.
15.	Heber Valley	Do.
16.	Duchesne River area	Unconsolidated and consolidated
17.	Vernal area	Do.
18.	Sanpete Valley	Unconsolidated
19.	Juab Valley	Do.
20.	Central Sevier Valley	Do.
21.	Pavant Valley	Do.
22.	Sevier Desert	Do.
23.	Snake Valley	Do.
24.	Milford area	Do.
25.	Beaver Valley	Do.
26.	Upper Sevier Valleys	Do.
27.	Upper Fremont River valley	Unconsolidated and consolidated
28.	Monticello area	Unconsolidated
29.	Blanding area	Do.
30.	Parowan Valley	Unconsolidated and consolidated
31.	Cedar City Valley	Unconsolidated
32.	Beryl-Enterprise area	Do.
33.	Central Virgin River area	Unconsolidated and consolidated

SUMMARY OF CONDITIONS

The estimated total withdrawal of water from wells in Utah in 1976 was about 860,000 acre-ft (1,060 hm^3), which is about 70,000 acre-ft (86 hm^3) more than in 1975 and 140,000 acre-ft (173 hm^3) greater than the average annual withdrawal during 1966-75 (table 2). Both the increase over 1975 and the increase over the 10-year average were due primarily to increases in withdrawals for irrigation.

Total withdrawal for irrigation in 1976 was about 606,000 acre-ft (748 hm^3), which is about 56,000 acre-ft (69 hm^3) more than in 1975. Irrigation withdrawals in most major areas of ground-water development were greater in 1976 than in 1975. Slight decreases in irrigation withdrawals were reported in Pavant Valley and in the Beryl-Enterprise area.

The quantities of water withdrawn from wells for irrigation are closely related to local climatic conditions. Precipitation in 1976 was below average in most of Utah, especially during the latter part of the year (National Oceanic and Atmospheric Administration, 1977). Most areas had below-average snow cover, but reservoirs contained about 113 percent of their usable capacity on April 1, 1977.

Changes in ground-water levels in Utah from the spring of 1976 to the spring of 1977 reflected the generally decreased availability of surface water and the increase in ground-water withdrawals. Water levels generally declined in most major ground-water basins in the State.

The larger ground-water basins and those containing most of the ground-water development in Utah are shown in figure 1. Table 2 gives information about the number of wells constructed, withdrawals of water from wells for principal uses, and total withdrawals in 1976 for selected major ground-water basins. For comparison, total withdrawals in 1975 and average annual withdrawals during the 10-year period 1966-75 are also shown. The discussions that follow summarize the ground-water conditions in areas of major ground-water development.

Table 2.--Well construction and withdrawal of water from wells in Utah

Area	Number in figure 1	Number of wells completed in 1976[1]: Diameter: Less than 6 inches	Diameter: 6 inches or more	Large-withdrawal wells[2]	Estimated withdrawal from wells (acre-ft): 1976: Irrigation	1976: Industry	1976: Public supply	1976: Domestic and stock	1976: Total (rounded)	1975 total[3]	1966-75 average annual[4]
Cache Valley	5	0	3	2	11,800	8,700[5]	4,100	2,100	27,000	25,000	25,000
East Shore area	9	12	4	0	17,000[6]	6,100	17,500	-	41,000	41,000	45,000
Jordan Valley	10	6	65	4	4,600	36,200[7]	49,900	33,500[5]	124,000	122,000	117,000
Tooele Valley	11	0	20	1	25,500[6]	1,200	2,900	250	30,000	29,000	26,000
Utah and Goshen Valleys	14	30	78	5	62,100	13,300	18,600	12,700[8]	107,000	98,000	89,000
Juab Valley	19	0	6	2	29,200	50	0	200	29,000	25,000	22,000
Sevier Desert	22	5	14	0	28,800	2,000	1,500	1,100	33,000	26,000	26,000
Sanpete Valley	18	1	28	2	20,200	700	1,100	3,100[8]	25,000	15,000	16,000
Upper and central Sevier and upper Fremont River Valleys[9]	26,20,27	0	55	0	15,700	100	2,800	6,300	25,000	24,000	23,000
Pavant Valley	21	0	6	5	94,400	100	400	300	95,000	98,000	82,000
Cedar City Valley	31	0	12	4	34,000[10]	1,000	1,900	200	37,000	28,000	30,000
Parowan Valley	30	0	9	2	33,500[10,11]	0	250	150	34,000	28,000	24,000
Escalante Valley Milford area	24	0	9	2	64,300[10]	0	800	200	65,000	60,000	55,000
Beryl-Enterprise area	32	0	3	1	78,300[10]	0	300	650	79,000	85,000	78,000
Other areas[12]		50	330	35	86,300	2,200	19,700	900	109,000	85,000	64,000
Totals (rounded)		104	642	65	606,000	72,000	122,000	62,000	860,000	790,000	720,000

[1] Compiled from data supplied by Utah Department of Natural Resources, Division of Water Rights. Includes deepened and replacement wells.
[2] Wells (6 inches or more in diameter) constructed for irrigation, industry, or public supply. Included under "6 inches or more."
[3] From Sumsion and others (1976, p. 6).
[4] Calculated from previous reports of this series. Some figures include unpublished revisions.
[5] Includes some use for fish and fur culture.
[6] Includes some domestic and stock use.
[7] Includes some use for air conditioning.
[8] Includes some use for irrigation.
[9] Upper Fremont River valley included in "Other areas" prior to 1976.
[10] Data from local water commissioners.
[11] Includes some use for stock.
[12] Withdrawals are estimated minimum amounts.

MAJOR AREAS OF GROUND-WATER DEVELOPMENT

CACHE VALLEY

By W. N. Jibson

Total discharge from pumped and flowing wells in Cache Valley in 1976 was about 27,000 acre-ft (33 hm^3), 2,000 acre-ft (2.5 hm^3) more than that reported in 1975 and for the 1966-75 average annual discharge (table 2). Withdrawals for public supply and irrigation increased about 24 percent and about 10 percent, respectively, over 1975. The increased demand was due to below-average precipitation during the latter part of 1976.

In most of Cache Valley, water levels declined from March 1976 to March 1977 (fig. 2), owing to below-average precipitation. Declines of more than 5 ft (1.5 m) occurred in a small area southwest of Richmond. Rises of less than 2 ft (0.6 m) occurred in the Mendon-Cache Junction area in the western part of the valley.

The long-term trend in the water level in well (A-12-1)29cab-1, the annual discharge of Logan River near Logan, and the cumulative departure from the average annual precipitation at Utah State University at Logan are shown for comparison in figure 3. Precipitation prior to September was enough above average to largely offset critically low amounts in the latter part of the year, and the annual departure was only 0.39 in. (9.9 mm) below the 1941-75 average of 17.77 in. (252 mm). Discharge of the Logan River during the year was 170,100 acre-ft (210 hm^3), only 76 percent of 1975, and about 12,000 acre-ft (15 hm^3) below the 1941-75 average.

EAST SHORE AREA

by E. L. Bolke

The withdrawal of water from wells in the East Shore area in 1976 was about 41,000 acre-ft (51 hm^3), the same as that reported for 1975, and 4,000 acre-ft (4.9 hm^3) less than the 1966-75 average (table 2).

From March 1976 to March 1977, water levels declined in the East Shore area (fig. 4). The declines were due to below-average precipitation during 1976. The largest declines were southeast of Kaysville and south of Willard.

The long-term relation between water levels in selected wells and precipitation at Ogden Pioneer powerhouse is shown in figure 5. Water levels in three of four observation wells have generally remained unchanged during the previous 10 years despite above-normal precipitation. The water level in the fourth well, at Bountiful, shows a general rise during the previous 10 years due to increased precipitation and importation of water from the Weber River.

JORDAN VALLEY

by R. W. Mower

The withdrawal of water from wells in Jordan Valley in 1976 was 124,000 acre-ft (153 hm^3), an increase of 2,000 acre-ft (2.5 hm^3)--about 2 percent--from 1975 and an increase of 7,000 acre-ft (8.6 hm^3)--about 6 percent--above the annual average reported for the previous 10 years, 1966-75 (table 2). Withdrawals in 1976 for industry were slightly lower than in 1975, chiefly because some industrial wells were inoperative during most of the year. Withdrawals for domestic and stock and for irrigation did not change from 1975 to 1976, but withdrawals for public supply increased moderately. This increase resulted from below-average precipitation (figs. 6 and 8), which diminished the availability of surface supplies, and the growth in population, which increased the normal demand for water.

Water levels declined from February 1976 to February 1977 in about 95 percent of Jordan Valley (fig. 7) and rose in about 5 percent; the average change in water level in the valley was a decline of almost 3 ft (0.9 m). The maximum observed decline was slightly more than 10 ft (3.0 m) in the northeastern part of Salt Lake City and in a small area about 3 mi (5 km) northeast of Sandy City. Water levels rose slightly more than 2 ft (0.6 m) in an area about 3 mi (5 km) southwest of Kearns and slightly less than 5 ft (1.5 m) in an area at the southeast edge of Herriman. The rises were in areas where the volume of recharge locally was greater than average. The maximum declines were due to pumping at wells used for public supply much later in the year than normal; water levels at these wells had not fully recovered by February 1977.

The relation between fluctuations of water levels in selected wells and precipitation is illustrated in figure 8. Precipitation at Silver Lake Brighton during 1976 was 25.38 in. (645 mm) below the average for 1931-75. The below-average precipitation is reflected by a decline of water levels at four of the five observation wells.

TOOELE VALLEY

by A. C. Razem

During 1976 approximately 30,000 acre-ft (37 hm^3) of water was withdrawn from wells in Tooele Valley. This amount is 1,000 acre-ft (1.2 hm^3) more than reported for 1975 and 4,000 acre-ft (4.9 hm^3) more than the average annual withdrawal for the previous 10 years, 1966-75 (table 2). The increase in withdrawals was due to increased demand for water for irrigation and public supply.

The discharge from springs in 1976 was approximately 21,000 acre-ft (26 hm^3), the same as reported in 1975. About 4,000 acre-ft (4.9 hm^3) of the water was used for irrigation and stock in the valley, and about 17,000 acre-ft (21 hm^3) was diverted to Jordan Valley for industrial use.

Water levels declined in most of the valley from March 1976 to March 1977 (fig. 9), owing to below-average precipitation and increased withdrawals from wells during 1976. Declines of more than 2 ft (0.6 m) occurred in the Grantsville and Burmester districts. The maximum water-level rises, which were less than 2 ft (0.6 m), were recorded near the center of the valley and east of Erda.

The relation between water levels in selected wells and precipitation at Tooele is shown in figure 10. Of the seven wells shown, water levels declined in five wells and rose in two. Precipitation at Tooele in 1976 was about 80 percent of the 1936-75 average.

UTAH AND GOSHEN VALLEYS

by R. M. Cordova

Withdrawal of water from wells in Utah and Goshen Valleys in 1976 was about 107,000 acre-ft (132 hm^3), which is the largest withdrawal of record. This withdrawal is 9,000 acre-ft (11.1 hm^3) more than reported for 1975 and 18,000 acre-ft (22 hm^3) more than the average annual withdrawal for the previous 10 years, 1966-75 (table 2). Withdrawals in 1976 were significantly more than in 1975 for irrigation and public supply by 7,600 acre-ft (9.4 hm^3) and 2,100 acre-ft (2.6 hm^3), respectively. In Utah Valley, about 87,400 acre-ft (108 hm^3) was withdrawn in 1976, or about 10,400 acre-ft (13 hm^3) more than in 1975; in Goshen Valley, 19,300 acre-ft (24 hm^3) was withdrawn in 1976 or 1,700 acre-ft (2.1 hm^3) less than in 1975.

Water levels in most observation wells declined from March 1976 to March 1977 (figs. 11-15). The general decline resulted from increased ground-water withdrawal and below-average precipitation (fig. 15). The water-level rise in much of Goshen Valley resulted from decreased pumping at many wells in 1976.

JUAB VALLEY

by V. L. Jensen

The withdrawal of water from wells in Juab Valley during 1976 was about 29,000 acre-ft (36 hm^3), an increase of 4,000 acre-ft (4.9 hm^3) from that reported for 1975 and 7,000 acre-ft (8.6 hm^3) more than the 1966-75 average (table 2). The increase in withdrawals was due to decreased availability of surface water.

Water levels declined from March 1976 to March 1977 throughout most of Juab Valley (fig. 16), owing to below-average precipitation and withdrawals of ground water in excess of recharge.

The relation of water levels in selected wells and the cumulative departure from the 1935-75 average annual precipitation at Nephi is shown in figure 17. Water levels declined in both wells; precipitation at Nephi for 1976 was 6.81 in. (173 mm) below the 1935-75 average.

SEVIER DESERT

by R. W. Mower

The withdrawal of water from wells in the Sevier Desert in 1976 was about 33,000 acre-ft (41 hm^3). This amount was 7,000 acre-ft (8.6 hm^3)--about 27 percent--more than was reported for 1975 and also about 7,000 acre-ft (8.6 hm^3) more than the average annual withdrawal for the previous 10 years, 1966-75 (table 2). The increase from 1975 to 1976 was due chiefly to withdrawals for the irrigation of lands that had insufficient supplies from surface-water sources. During 1976, discharge of the Sevier River near Juab, the nearest gaging station above all diversions in the Sevier Desert, was about 159,100 acre-ft (196 hm^3) (fig. 20). This was 2,100 acre-ft (2.6 hm^3), or about 1 percent more than the 1975 figure, and about 18,150 acre-ft (22.4 hm^3), or about 13 percent more than the average discharge for 1935-75.

Water levels declined from March 1976 to March 1977 in 99 percent of the lower artesian aquifer and in 92 percent of the upper artesian aquifer in the part of the Sevier Desert covered by the observation-well network (figs. 18 and 19). The maximum observed water-level decline in the lower aquifer was 7.2 ft (2.2 m) about 1 mi (1.6 km) northwest of Oak City. The maximum observed decline in the upper artesian aquifer was 4.5 ft (1.4 m) about 2 mi (3.2 km) north of Oak City.

Water levels rose less than 1 ft (0.3 m) in the lower artesian aquifer about 7 mi (11 km) northwest of Delta. A similar water-level rise was observed in wells in the upper artesian aquifer about 10 mi (16 km) northwest of Delta and in two areas about 30 mi (48 km) north of Delta.

The long-term relation between precipitation at Oak City, discharge of the Sevier River near Juab, and water levels in selected wells is shown in figure 20. Precipitation at Oak City in 1976 was about 4 in. (102 mm) below the 1935-75 average. The water levels declined in all three observation wells from March 1976 to March 1977, indicating that the withdrawal from wells in 1976 exceeded the recharge in much of the Sevier Desert.

SANPETE VALLEY

by M. D. ReMillard

Approximately 25,000 acre-ft (31 hm^3) of water was withdrawn from wells in Sanpete Valley during 1976. This is 10,000 acre-ft (12.3 hm^3) more than the amount withdrawn in 1975 and 9,000 acre-ft (11.1 hm^3) more than the average annual withdrawal for the period 1966-75 (table 2). Withdrawals of water from irrigation wells during 1976 was much more than in 1975 due to less precipitation and a decrease of surface water available for irrigation.

From March 1976 to March 1977 water levels declined in most of Sanpete Valley (fig. 21). The declines were due mainly to increased withdrawals of ground water for irrigation.

Long-term hydrographs of water levels in three wells in Sanpete Valley and the long-term trend of precipitation at Manti are shown in figure 22. Water-level declines in two of the three wells reflected decreased precipitation and increased use of ground water throughout the area. During the last 6 years, despite below-average precipitation, water levels have not changed appreciably in Sanpete Valley.

UPPER AND CENTRAL SEVIER AND UPPER FREMONT RIVER VALLEYS

by G. W. Sandberg

The withdrawal of water from wells in the upper and central Sevier Valleys and upper Fremont River valley was about 25,000 acre-ft (31 hm^3) in 1976. This was 1,000 acre-ft (1.2 hm^3) more than in 1975 and 2,000 acre-ft (2.5 hm^3) more than the average annual withdrawal for the previous 10 years, 1966-75 (table 2).

Water levels rose in 9 observation wells and declined in 23 wells from March 1976 to March 1977 (fig. 23). The largest observed rise, 3.0 ft (0.9 m), was about 4 mi (6.4 km) east of Loa in the upper Fremont River valley, and the largest observed decline, 5.2 ft (1.6 m), was about 2 mi (3.2 km) north of Richfield. Most of the declines were in the central Sevier Valley.

The relation of water levels in selected wells to discharge of the Sevier River at Hatch and precipitation at Panguitch, Salina, and Loa is shown in figure 24. Precipitation was below average at all three stations. The discharge of the Sevier River at Hatch was about 25,000 acre-ft (31 hm^3) less than the 1940-75 average.

PAVANT VALLEY

by C. T. Sumsion

Withdrawal of water from wells in Pavant Valley in 1976 was 95,000 acre-ft (117 hm^3), which was 3,000 acre-ft (3.7 hm^3) less than reported for 1975, but 13,000 acre-ft (16 hm^3) more than the 1966-75 average (table 2). The decrease in withdrawals resulted from changes in irrigation methods. Precipitation was less than average, and less surface water was available for irrigation during 1976 than during 1975.

From March 1976 to March 1977, water levels declined throughout more than 80 percent of the area where data are available (fig. 25). The declines were in response to ground-water withdrawals in excess of recharge during 1976 as well as during the previous 2 years. The maximum measured decline was 18.64 ft (5.68 m) in a well at Meadow. The maximum measured rise was 6.71 ft (2.05 m) in a well about 4 mi (6.4 km) northwest of Holden.

The relation between water levels in selected wells and cumulative departure from the 1931-75 average precipitation at Fillmore is shown in figure 26. Water levels declined in five of the observation wells and rose in two wells. Precipitation was about 40 percent less than average.

Some of the water pumped for irrigation in Pavant Valley returns to the ground-water system as recharge and is then withdrawn again for irrigation. Such recirculation of ground water affects its chemical quality (Handy and others, 1969, p. D228-D234). The concentration of dissolved solids in 1976 compared to the most recent preceding measurement was greater in water from four observation wells and less in water from the well in the Meadow district. The general trend since 1957 shows increased concentrations of dissolved solids at all wells shown in figure 27.

CEDAR CITY VALLEY

by G. W. Sandberg

Approximately 37,000 acre-ft (46 hm^3) of water was pumped from wells in Cedar City Valley during 1976. This was 9,000 acre-ft (11.1 hm^3) more than was pumped in 1975 and 7,000 acre-ft (8.6 hm^3) more than the average annual withdrawal for the previous 10 years, 1966-75 (table 2).

Water levels declined throughout the valley except in one small area about 8 mi (12.9 km) north of Cedar City (fig. 28). The largest declines, more than 6 ft (1.8 m), were northwest of Cedar City, and they reflect the increased pumping and the decreased ground-water recharge due to below-average discharge of Coal Creek.

Figure 29 shows annual pumpage in Cedar City Valley, annual discharge of Coal Creek, departure from average precipitation at Cedar City, and water levels in well (C-35-11)33aac-1. Below-average precipitation, and consequently decreased streamflow, account for the near-record pumpage and declining water levels. The water level in well (C-35-11)33aac-1 was the lowest of record in October 1976.

PAROWAN VALLEY

by G. W. Sandberg

Approximately 34,000 acre-ft (42 hm^3) of water was withdrawn from wells in Parowan Valley in 1976, an increase of 6,000 acre-ft (7.4 hm^3) over 1975 and 10,000 acre-ft (12.3 hm^3) more than the average annual withdrawal for the previous 10 years, 1966-75 (table 2). The increase was due mostly to water pumped for irrigation (table 2).

Ground-water levels declined throughout the entire valley between March 1976 and March 1977. Declines ranged from less than 2 ft (0.6 m) in the northern part of the valley to more than 9 ft (2.7 m) in a large area northwest of Parowan and a small area northeast of Paragonah (fig. 30). The large areas of declining water levels reflect withdrawals of ground water in excess of recharge. The water-level decline pattern for 1976 was approximately the same as for the previous 2 years (Eychaner and others, 1975, fig. 30; Sumsion and others, 1976, fig. 30), but declines were generally larger in 1976.

The relation between water levels in well (C-34-8)5bca-1, average annual pumpage in Parowan Valley, and precipitation at Parowan is shown in figure 31. Water levels declined in 1976 for the third consecutive year as a result of heavy pumping for irrigation and below-average precipitation during relatively long growing seasons. Below-average precipitation also resulted in less surface water for irrigation.

ESCALANTE VALLEY

Milford area

by R. W. Mower

The withdrawal of water from wells in the Milford area in 1976 was about 65,000 acre-ft (80 hm^3), which was 5,000 acre-ft (6.2 hm^3)--8 percent--more than was reported for 1975 and 10,000 acre-ft (12.3 hm^3) more than the average annual withdrawal for the previous 10 years, 1966-75 (table 2). The increase from 1975 to 1976 was due mainly to an increase in withdrawal for irrigation because less surface water was available than in 1975. During 1976 the discharge of the Beaver River at Rockyford Dam, near Minersville (fig. 33) was about 15,300 acre-ft (19 hm^3), about 4 percent less than during 1975, and about 10,400 acre-ft (13 hm^3)--about 40 percent--less than the annual average for 1932-75. Precipitation during 1976 was 1.11 in. (28 mm) less than during 1975. Most of the difference was during the irrigation season. This, together with the decrease in the discharge of the Beaver River, was largely the reason withdrawals for irrigation in 1976 were more than in 1975.

Water levels declined from March 1976 to March 1977 in about 90 percent of the Milford area (fig. 32). The average change in water level in the area was a decline of 0.8 ft (0.2 m). The maximum observed decline was slightly more than 4 ft (1.2 m) in a small area about 4-5 mi (6-8 km) south-southeast of Milford. The maximum observed rises were less than 1 ft (0.3 m) in two areas, about 7-12 mi (11-19 km) north-northeast of Milford and about 16-25 mi (26-40 km) west of Minersville. The major declines from March 1976 to March 1977 were due to above-average withdrawals locally for irrigation and to reduced recharge from canals and fields irrigated with surface water. Water levels rose in areas where there was no increase in withdrawals and where recharge may have been greater than normal due to locally heavy summer thunderstorms.

The relation between water levels in well (C-29-10)6ddc-2 near the middle of the pumped area, precipitation at Milford airport, discharge of the Beaver River, and ground-water withdrawals is shown in figure 33. Precipitation at Milford airport in 1976 was 0.44 in. (11 mm) below the 1932-75 average. The decline of water levels caused by the increased withdrawals and the decreased availability of surface water is represented by the water-level decline in well (C-29-10)6ddc-2.

Beryl-Enterprise area

by G. W. Sandberg

The withdrawal of water from wells in the Beryl-Enterprise area in 1976 was about 79,000 acre-ft (97 hm^3), a decrease of about 6,000 acre-ft (7.4 hm^3) from the amount reported in 1975, but 1,000 acre-ft (1.2 hm^3) more than the average annual withdrawal for the previous 10 years, 1966-75 (table 2). The decrease from 1975 to 1976 was due to decreased pumping for irrigation, which probably resulted from improved monitoring of the withdrawal from wells.

Water levels declined throughout the entire area. Declines were about the same as the previous year in the northern part of the area but were larger in the southern part (fig. 34).

The long-term relation between water levels in selected wells, precipitation, and pumpage for irrigation is shown in figure 35. The water level in well (C-35-17)25dcd-1 declined more from March 1976 to March 1977 than during the previous year, reflecting decreased recharge, even though pumpage was less. The largest declines were northeast of Enterprise and were probably caused by locally heavy pumping and less than normal recharge in this area.

Figure 36 shows the change in concentration of dissolved solids in the water from four wells. The concentration increased slightly in the northern and central parts of the area, remained about the same in the southern part, and decreased considerably in the eastern part. The increases were probably caused by continued recycling of irrigation water, whereas the reason for the decrease in the eastern part of the area is not known.

OTHER AREAS

by L. R. Herbert

Approximately 109,000 acre-ft (134 hm^3) of water was withdrawn from wells in areas of Utah outside of the major developed ground-water basins. This amount is 24,000 acre-ft (30 hm^3) more than reported in 1975 (not including Beaver Valley) and 45,000 acre-ft (56 hm^3) more than the 1966-75 average (table 2). The increase in withdrawals from wells in 1976 was due mainly to increased demands on ground water for irrigation.

Ground-water levels declined in most of these areas from March 1976 to March 1977. The decline in water levels was the result of locally heavy withdrawals of ground water and below-average precipitation. Water levels rose in a few areas where demands on ground water were slight.

Estimated total withdrawals of water in 1976 from wells in areas of Utah other than the major developed ground-water basins described in the preceding sections were as follows:

Area (see fig. 1)	Estimated withdrawal (acre-ft)
1. Grouse Creek valley	3,000
2. Park Valley	2,800
3. Curlew Valley	25,000
8. Ogden Valley	11,000
12. Dugway area (including Skull Valley north of area outlined in fig. 1)	5,000
13. Cedar Valley	2,800
23. Snake Valley	14,600
25. Beaver Valley	11,500
33. Central Virgin River area	12,300
Remainder of State	21,100
Total (rounded)	109,000

Figure 37 shows the relation of the long-term hydrographs of selected wells in other areas to the cumulative departure from average annual precipitation at sites in or near those areas.

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ILLUSTRATIONS

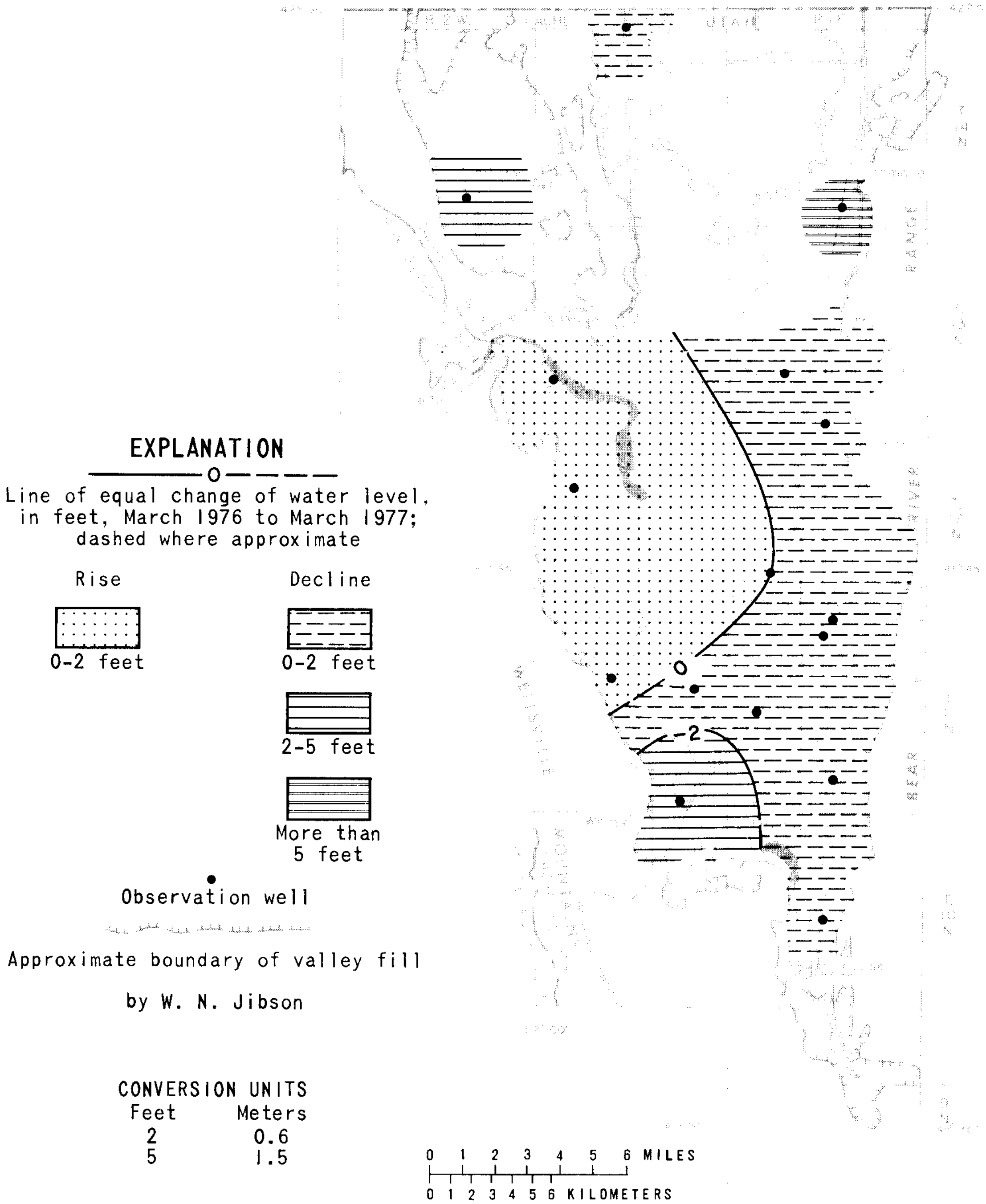


Figure 2.—Map of Cache Valley showing change of water levels from March 1976 to March 1977

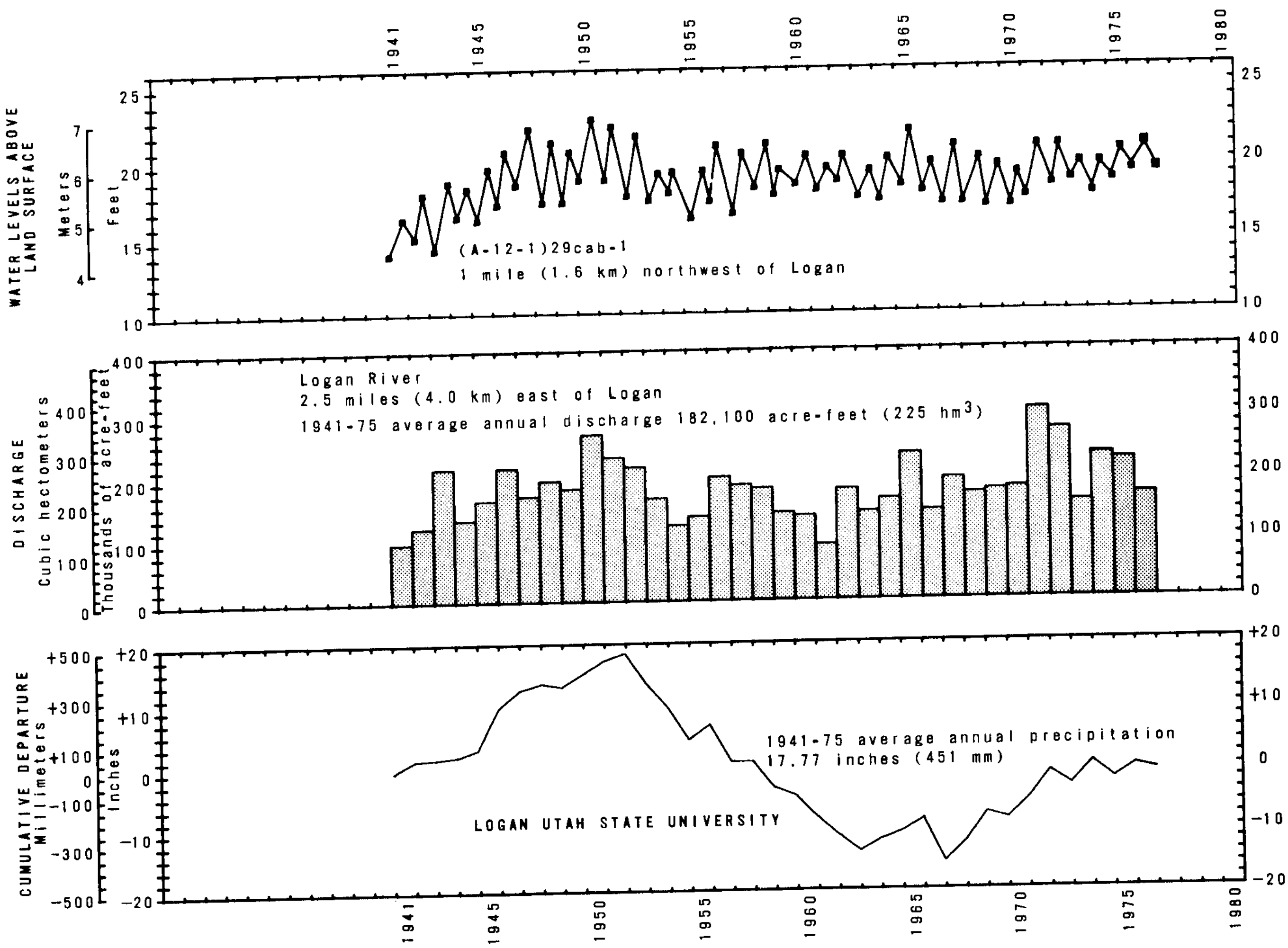


Figure 3.—Relation of water levels in well (A-12-1)29cab-1 in Cache Valley to discharge of the Logan River near Logan and to cumulative departure from the average annual precipitation at Logan Utah State University.

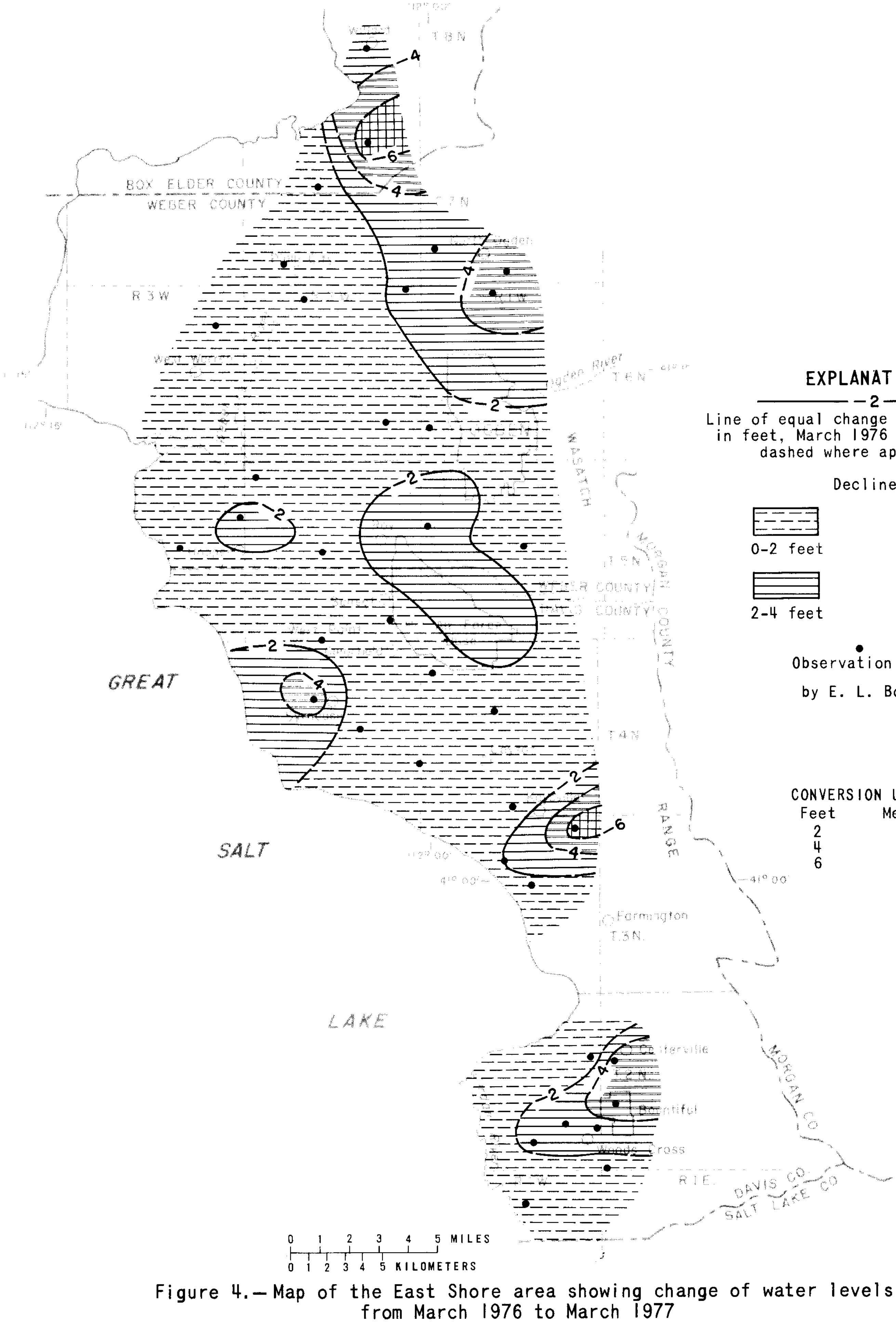


Figure 4.—Map of the East Shore area showing change of water levels from March 1976 to March 1977

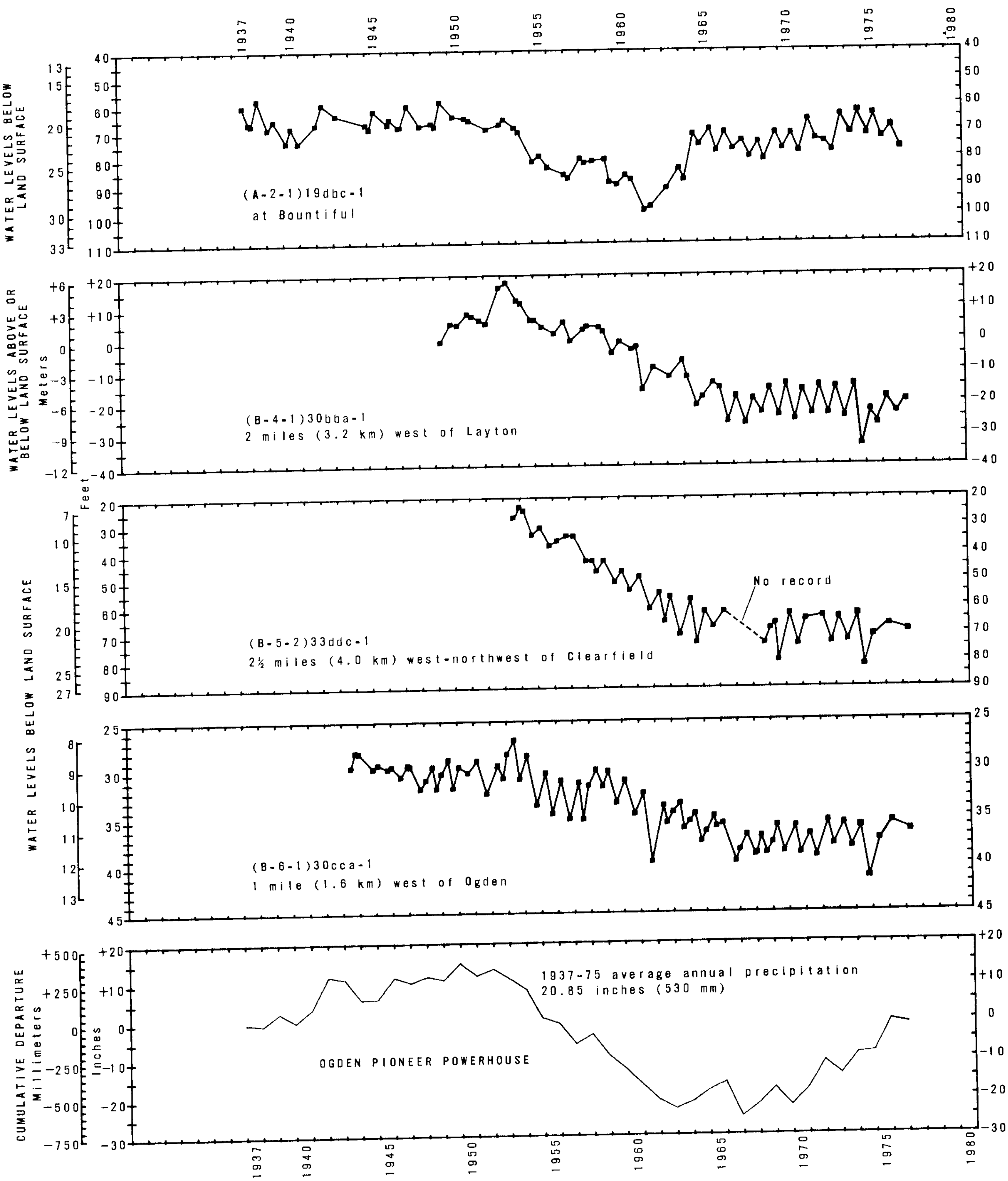


Figure 5.—Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer powerhouse.

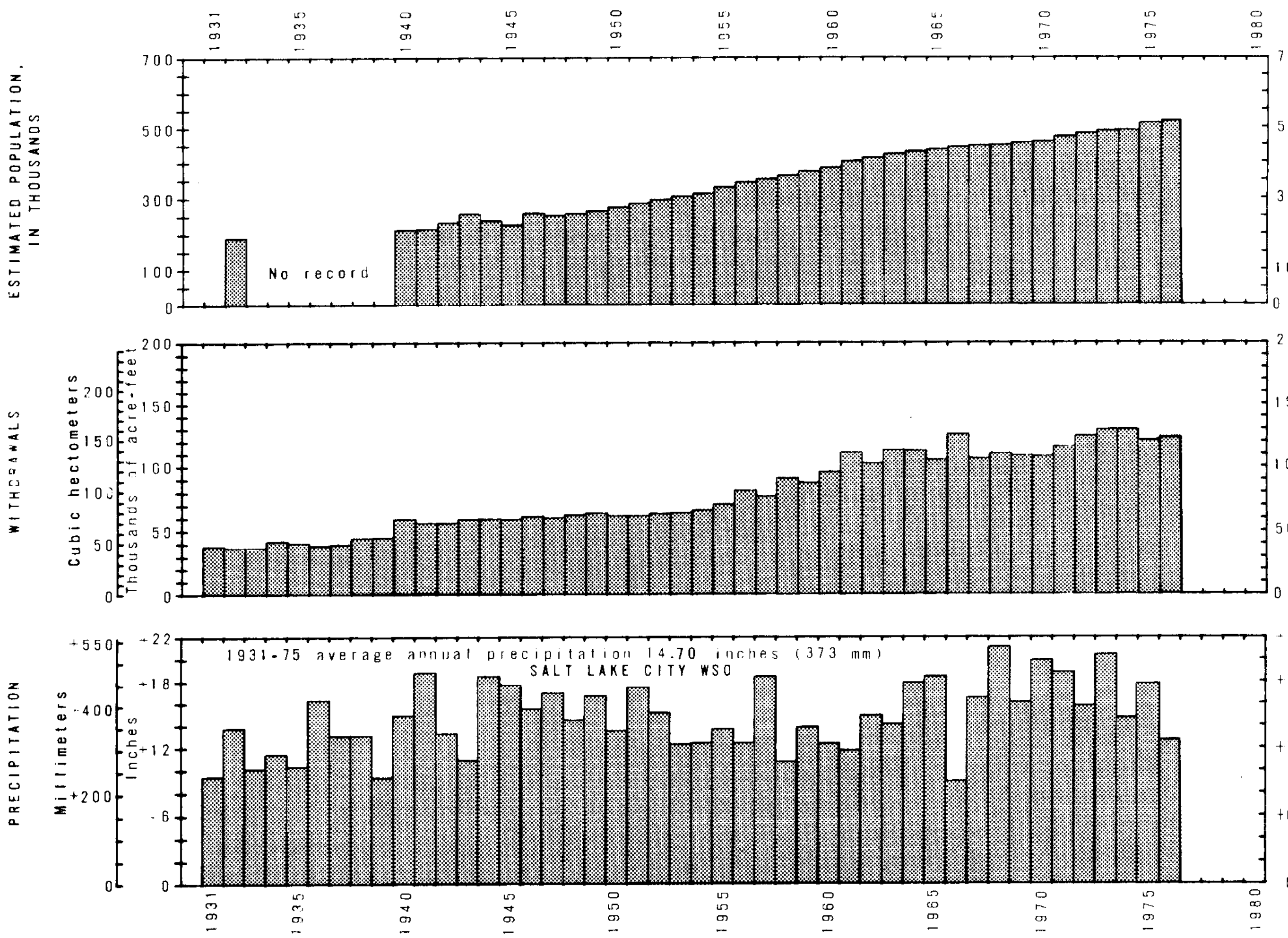


Figure 6.--Graphs showing estimated population of Salt Lake County, withdrawals from wells, and annual precipitation at Salt Lake City WSO (International Airport) for the period 1931-76

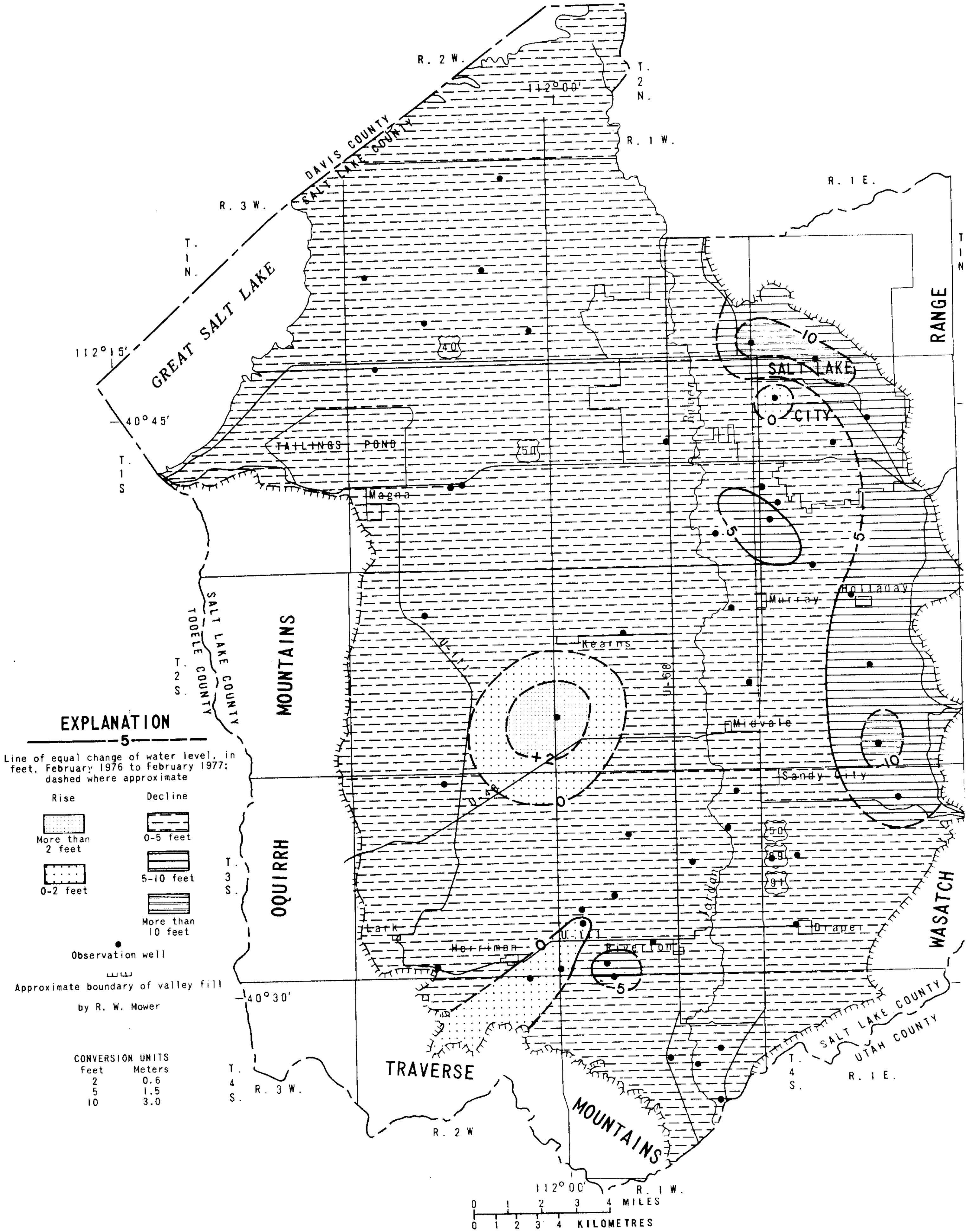


Figure 7.—Map of the Jordan Valley showing change of water levels from February 1976 to February 1977.

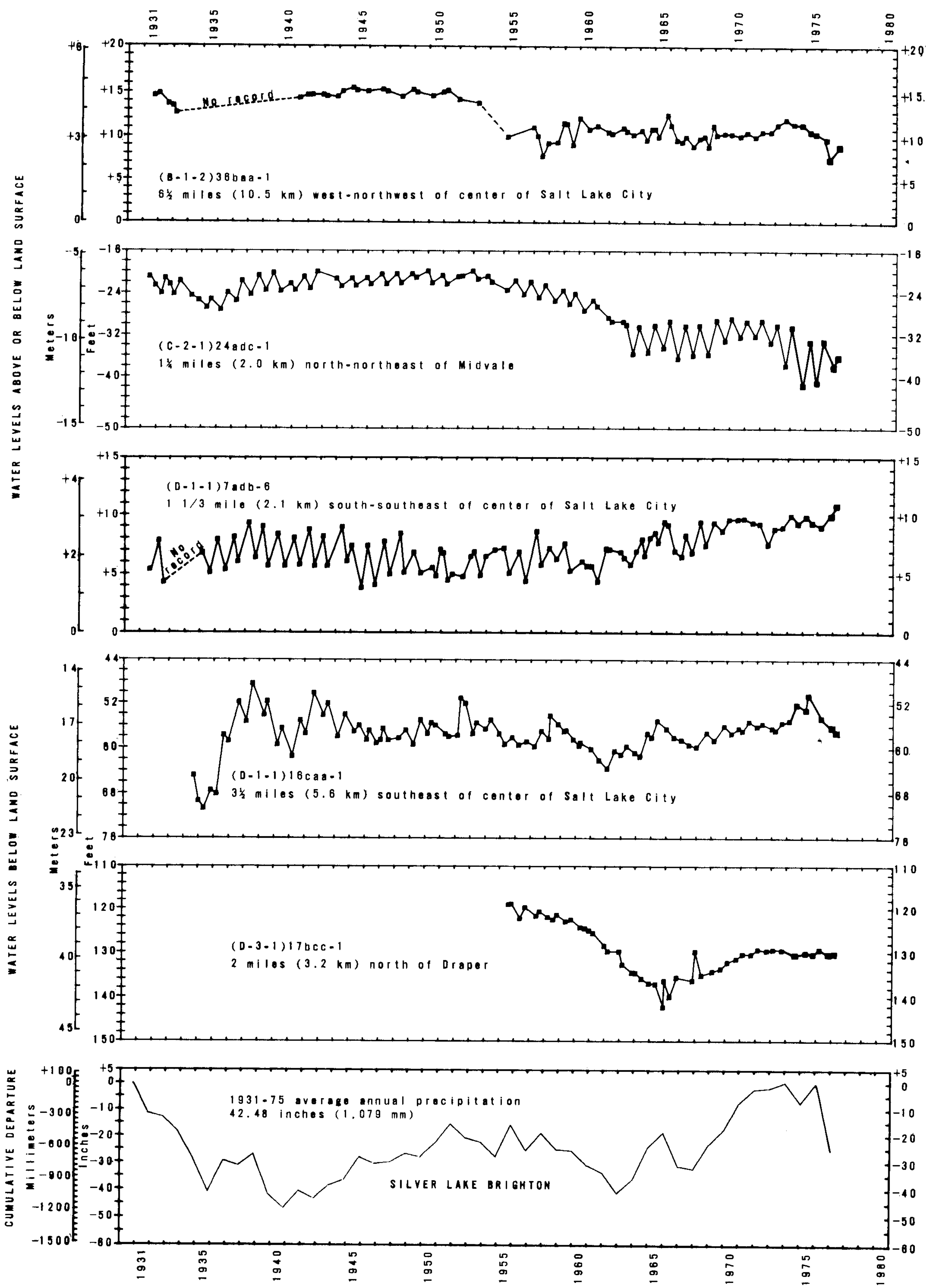


Figure 8.—Relation of water levels in selected wells in the Jordan Valley to cumulative departure from the average annual precipitation at Silver Lake Brighton.

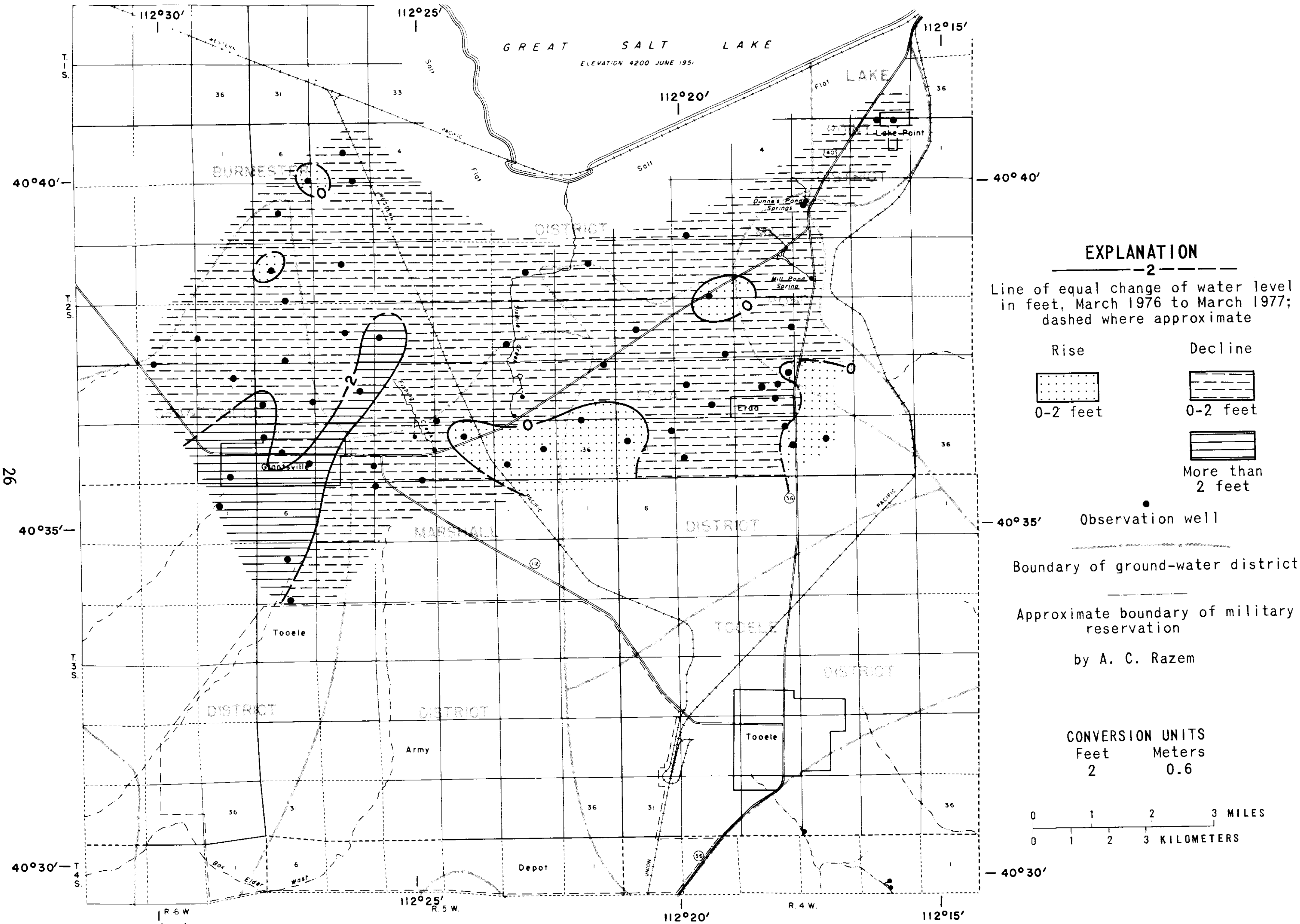


Figure 9.—Map of Tooele Valley showing change of water levels in artesian aquifers from March 1976 to March 1977.

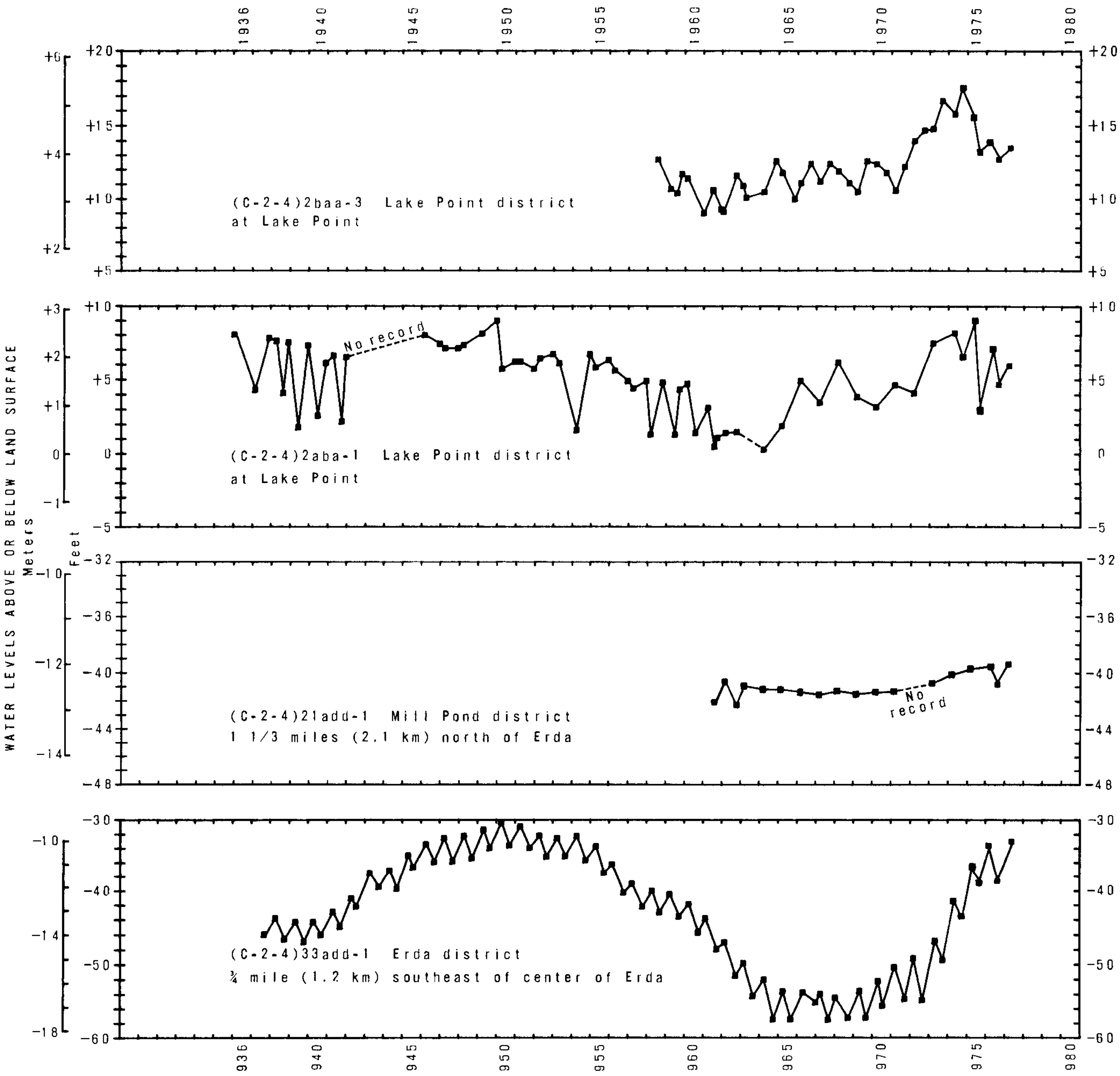


Figure 10.—Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele.

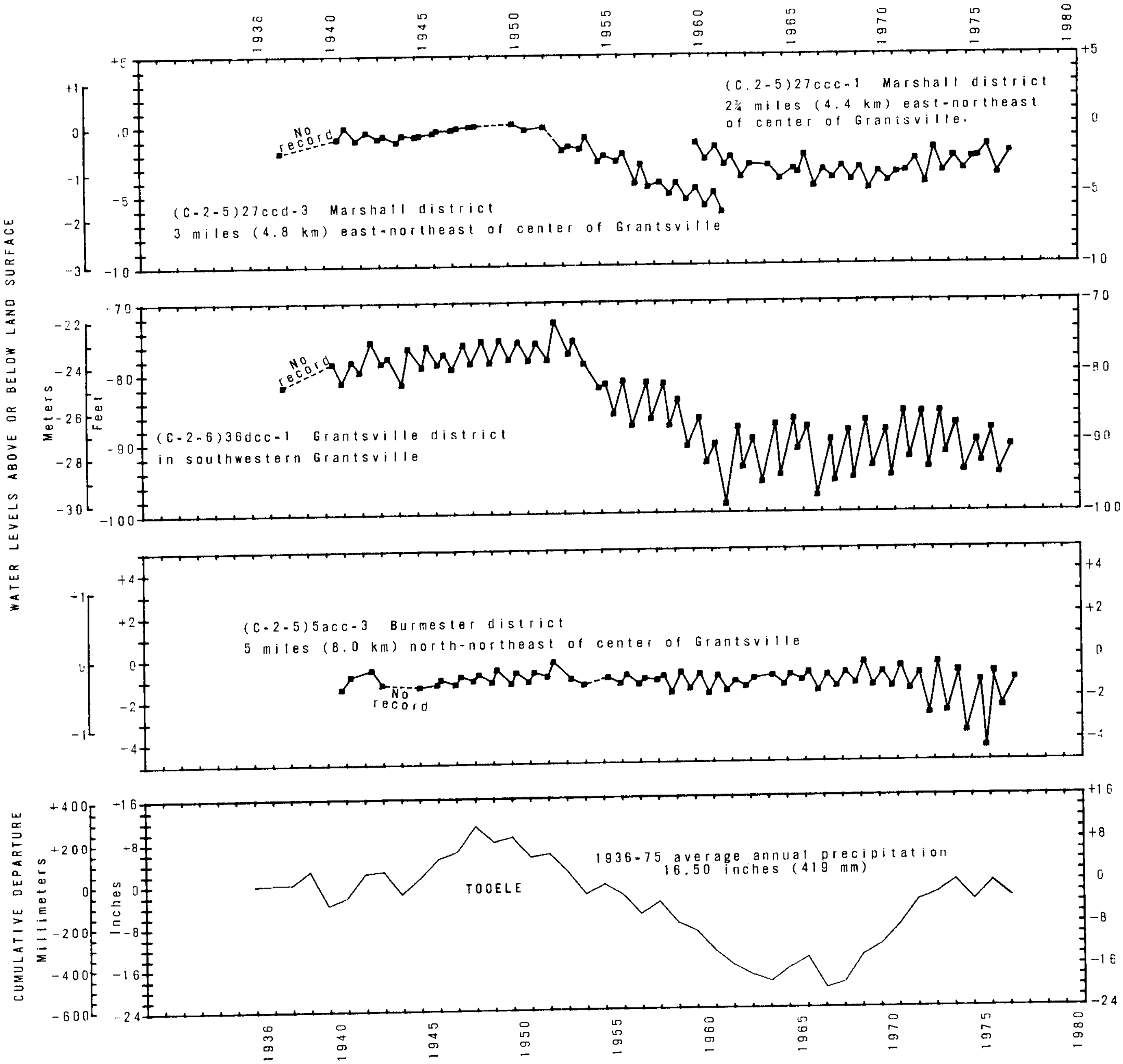


Figure 10.— Continued.

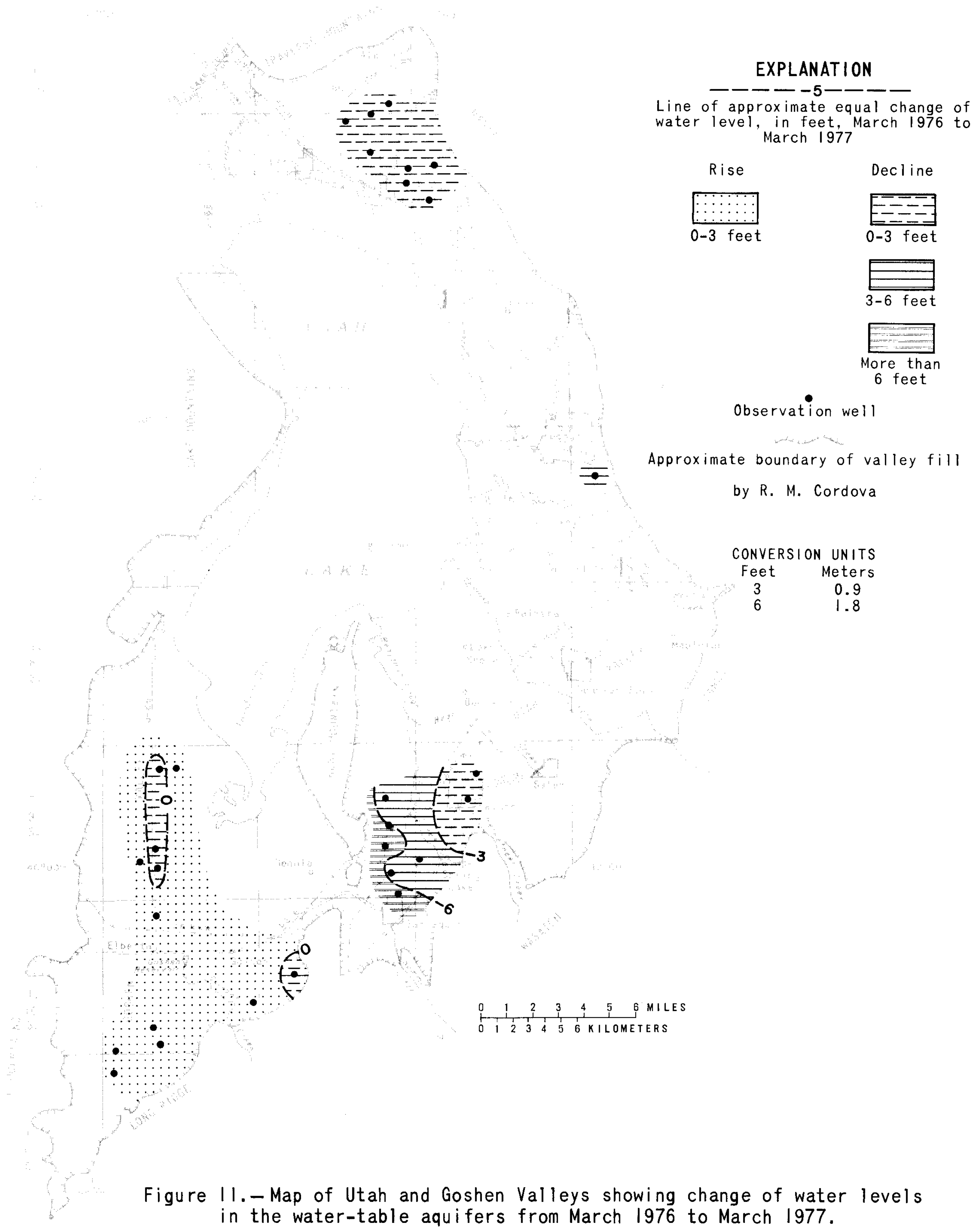


Figure 11.—Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March 1976 to March 1977.

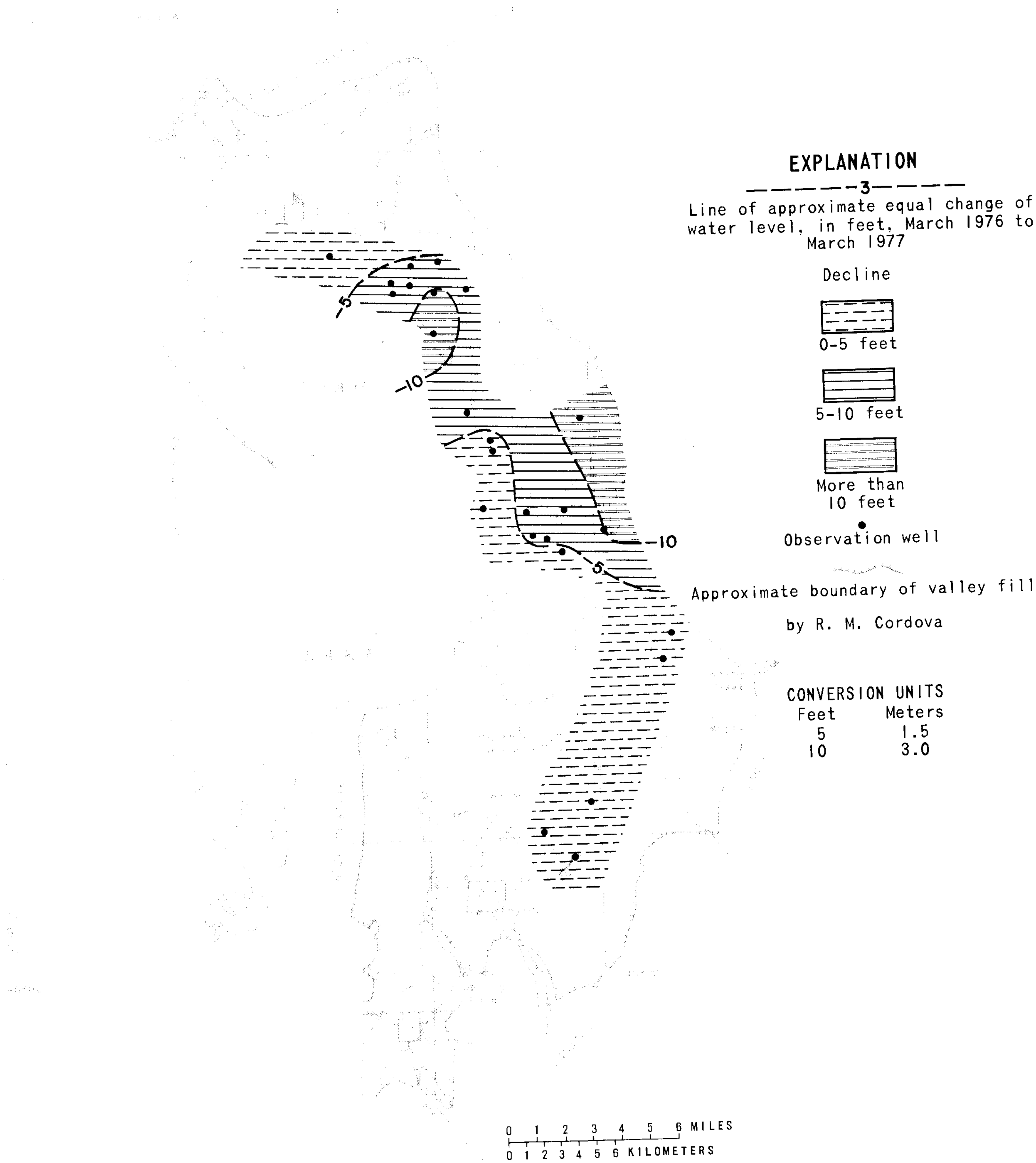


Figure 12.—Map of Utah Valley showing change of water levels in the shallow artesian aquifer in rocks of Pleistocene age from March 1976 to March 1977.

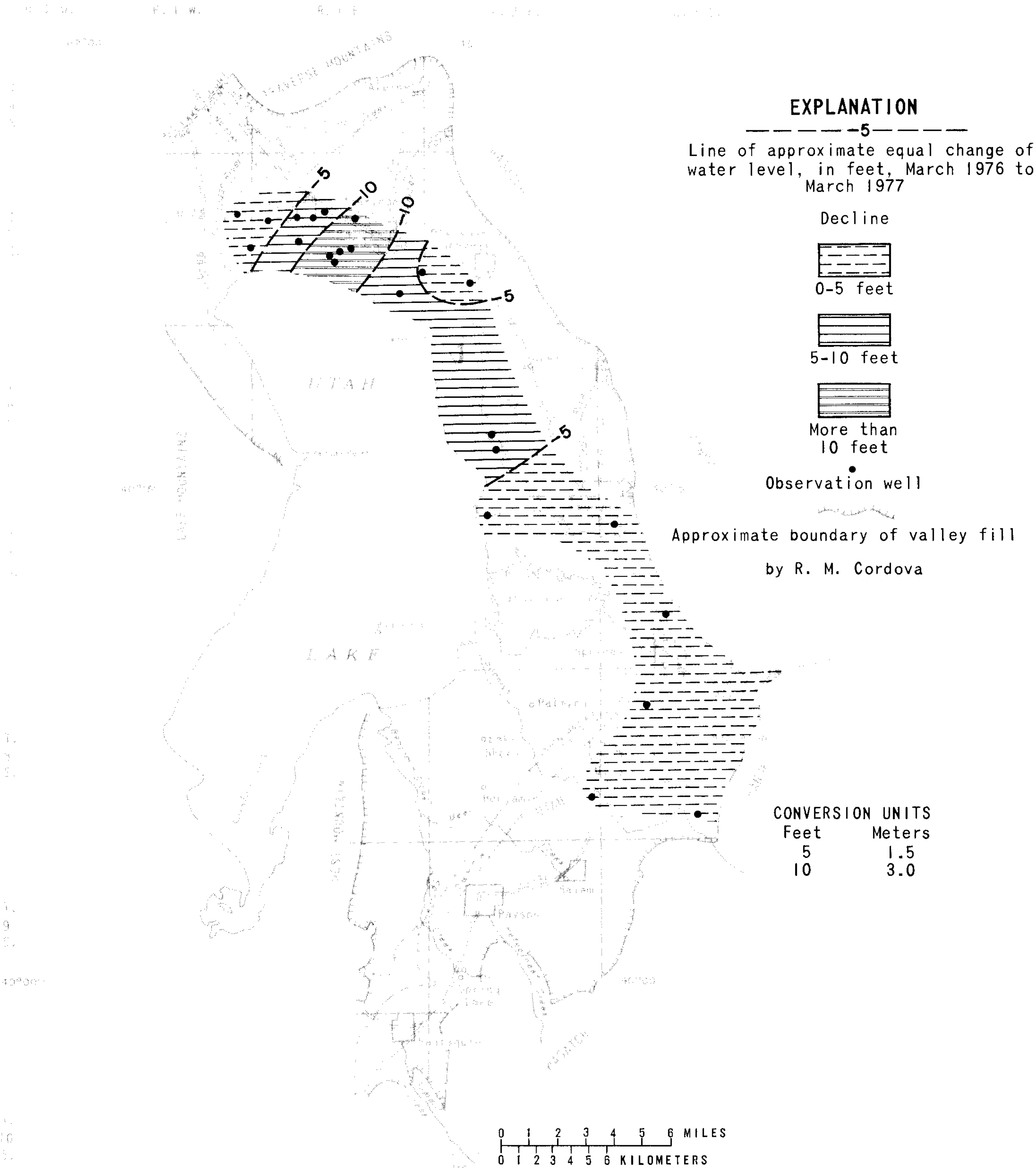


Figure 13.—Map of Utah Valley showing change of water levels in the deep artesian aquifer in rocks of Pleistocene age from March 1976 to March 1977.

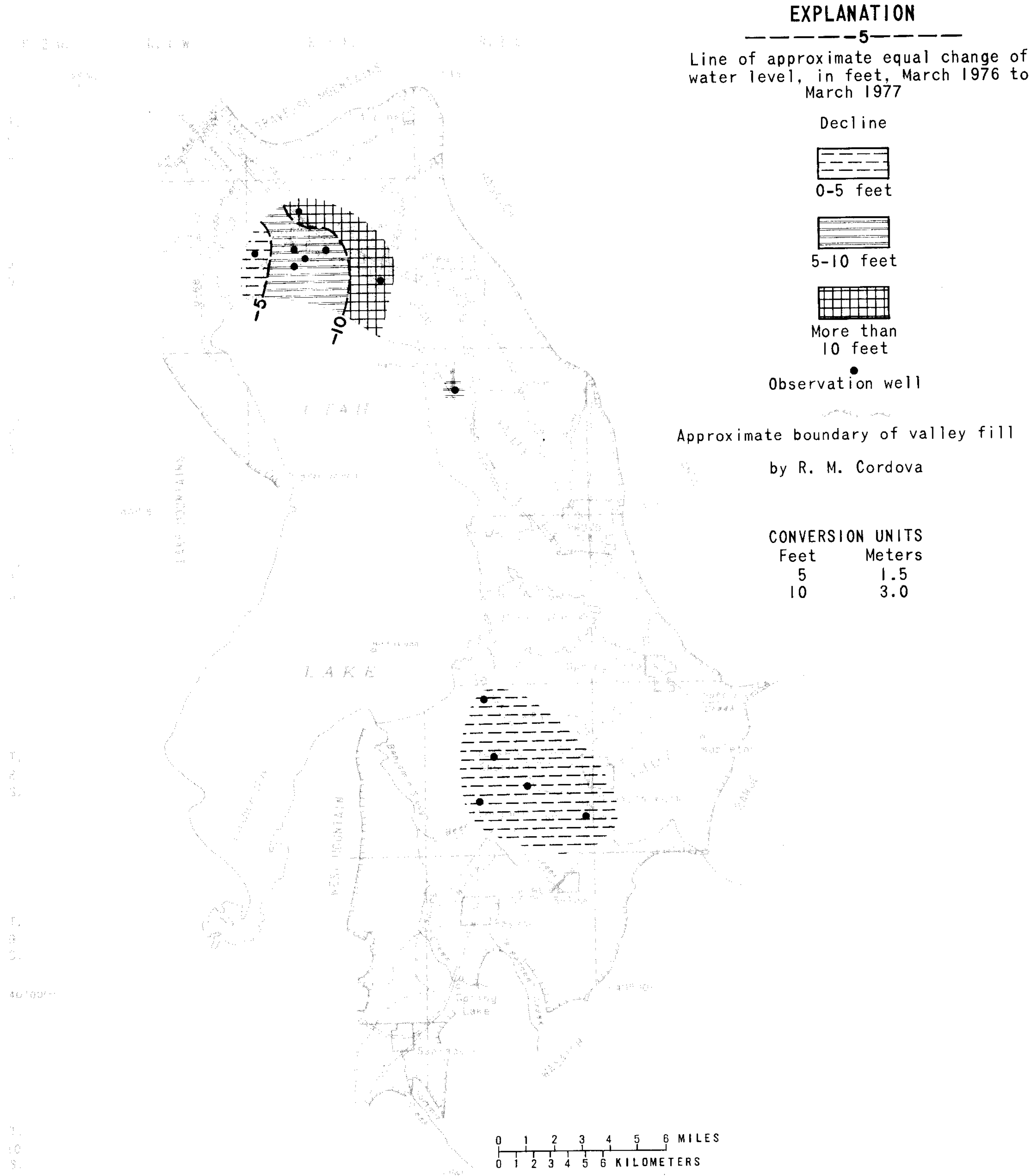


Figure 14.—Map of Utah Valley showing change of water levels in the artesian aquifer in rocks of Tertiary age from March 1976 to March 1977.

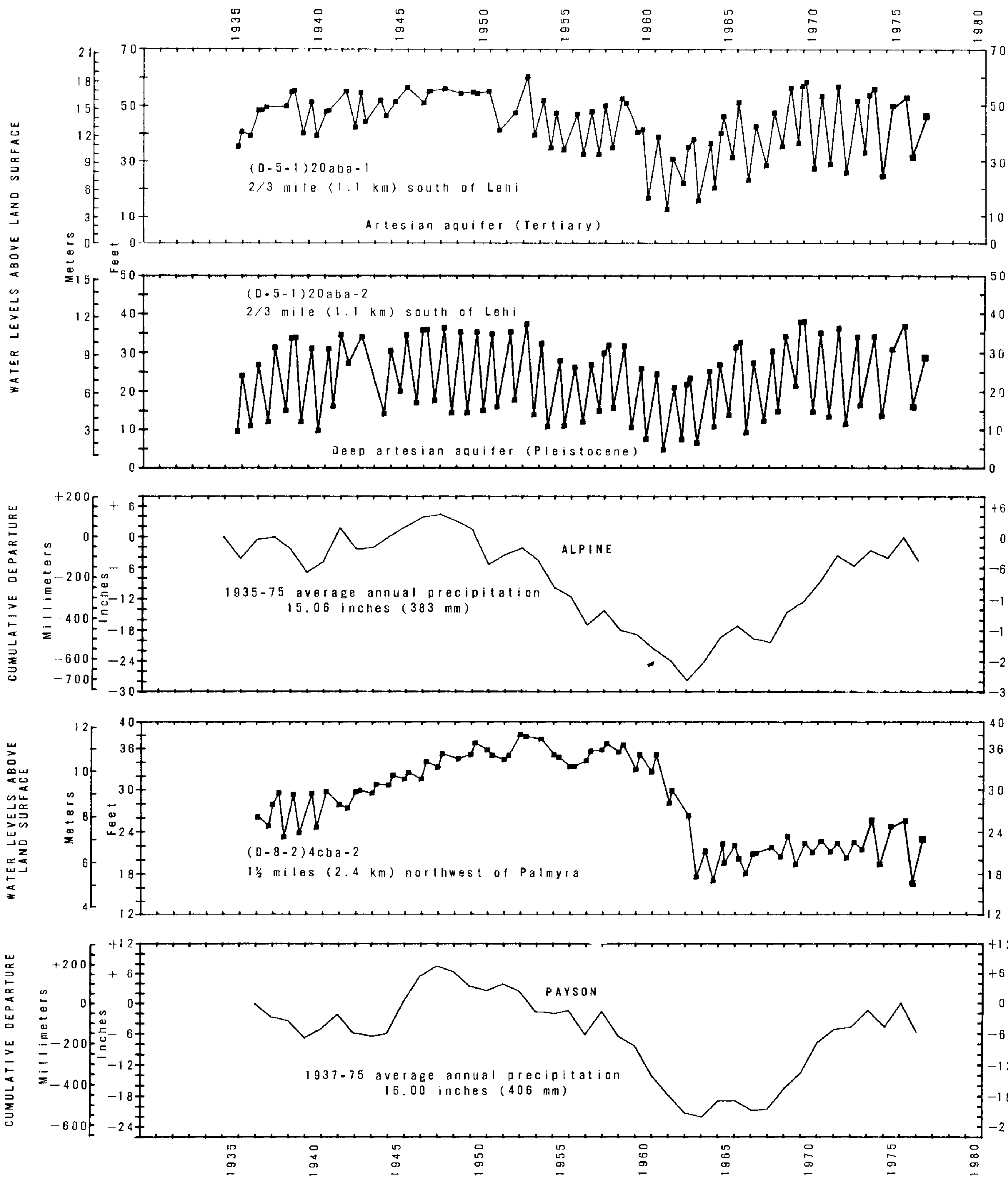
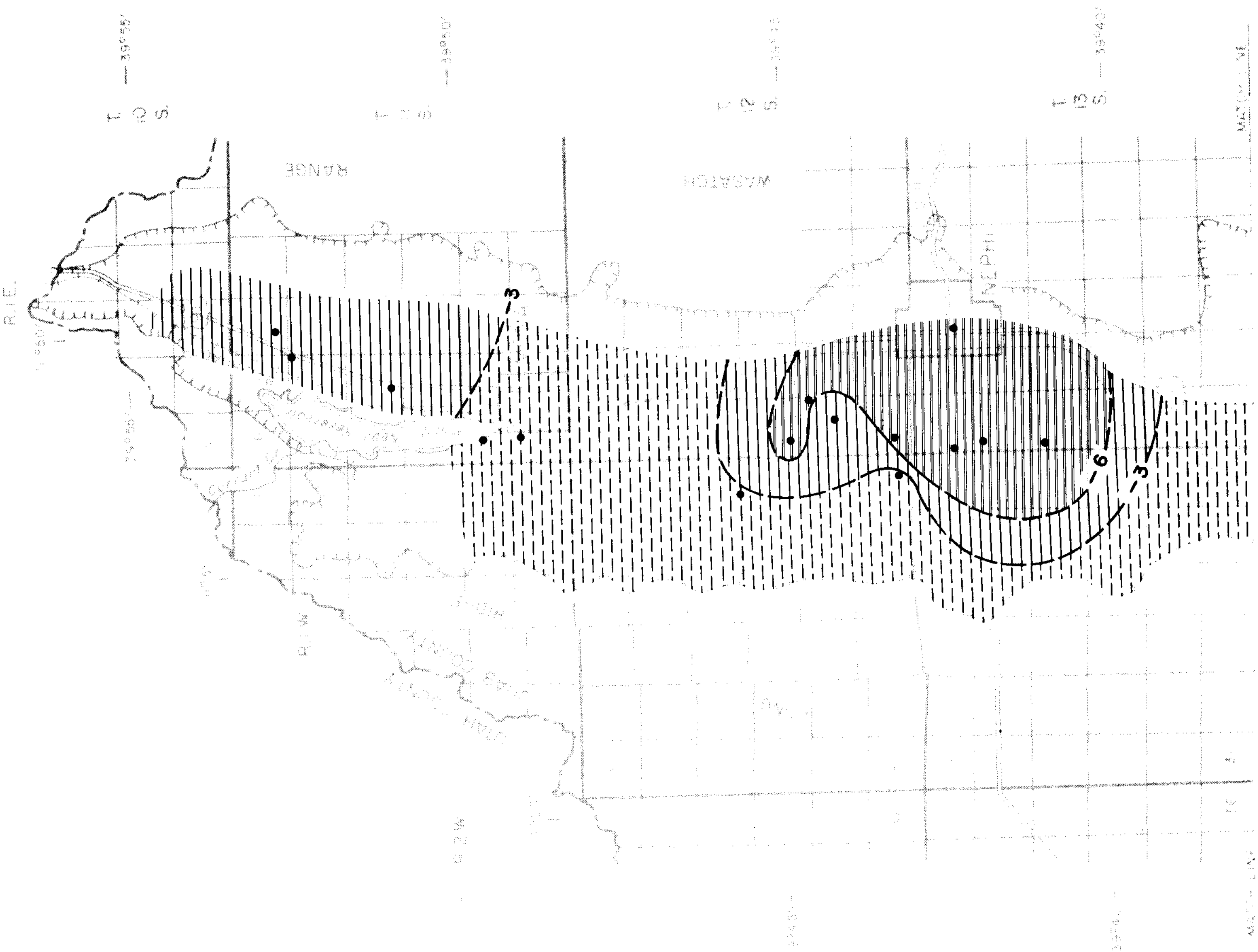


Figure 15.—Relation of water levels in selected wells in Utah Valley to cumulative departure from the average annual precipitation at Alpine and Payson.



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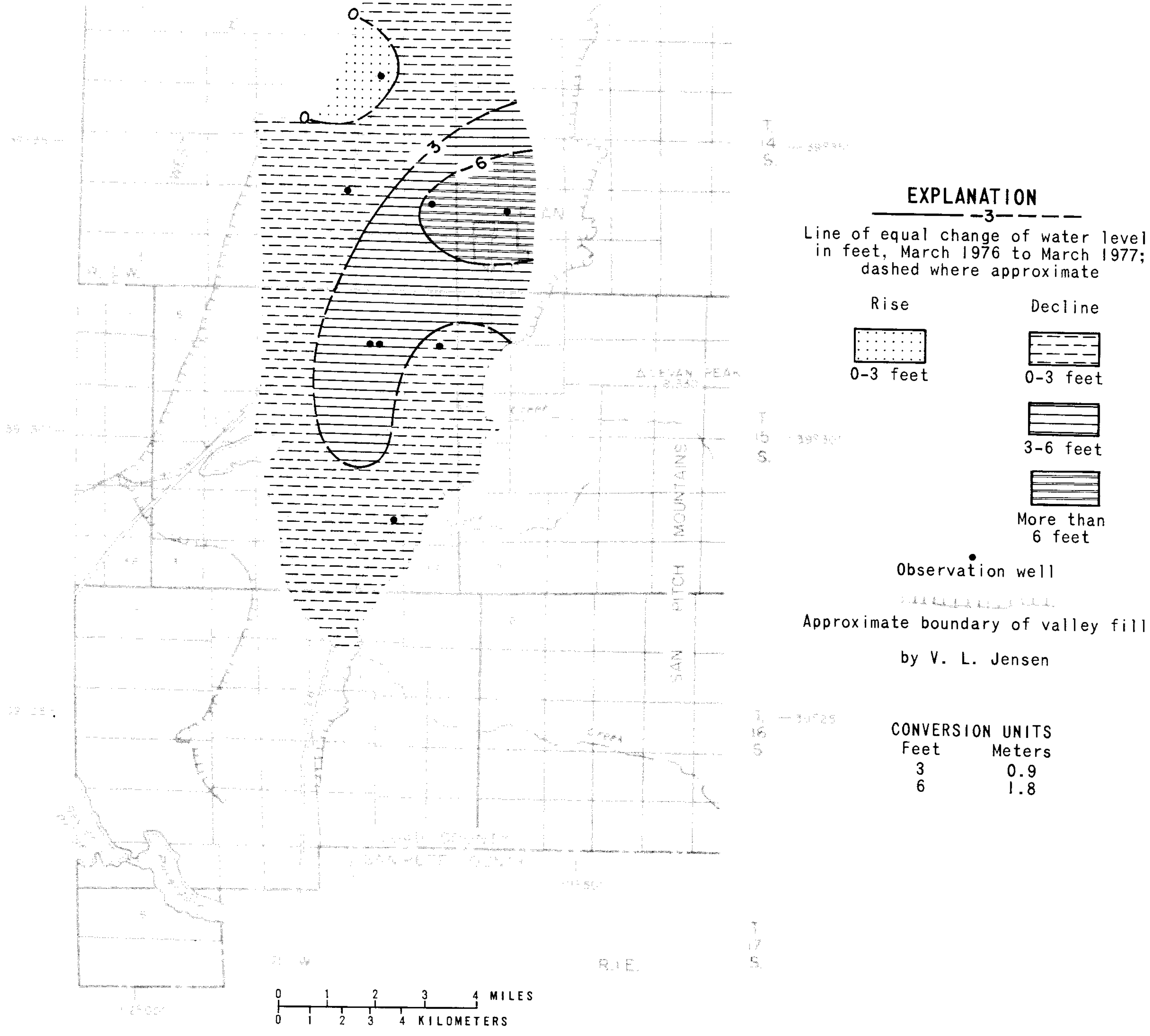


Figure 16.—Map of Juab Valley showing change of water levels from March 1976 to March 1977.

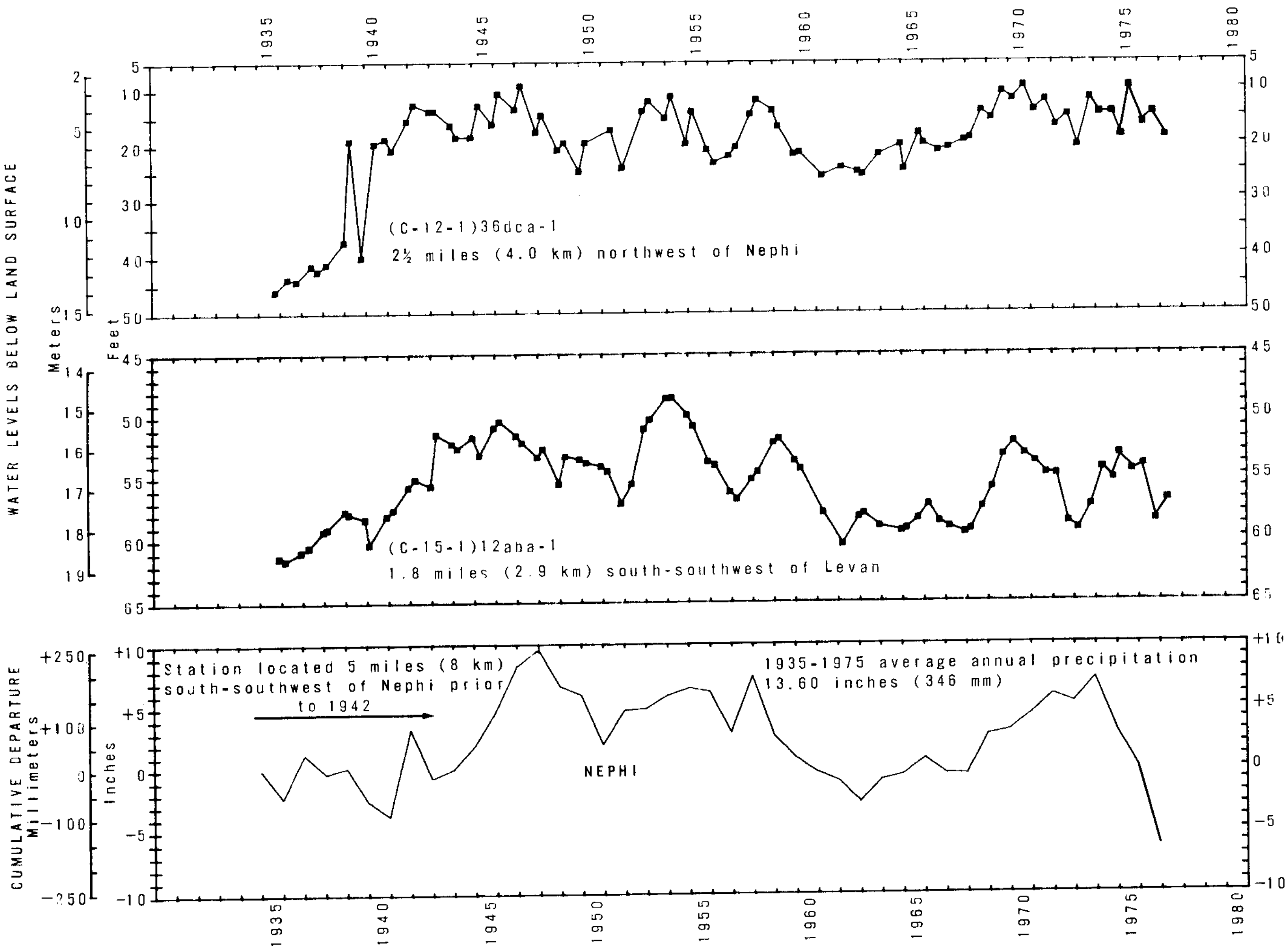


Figure 17.—Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi.

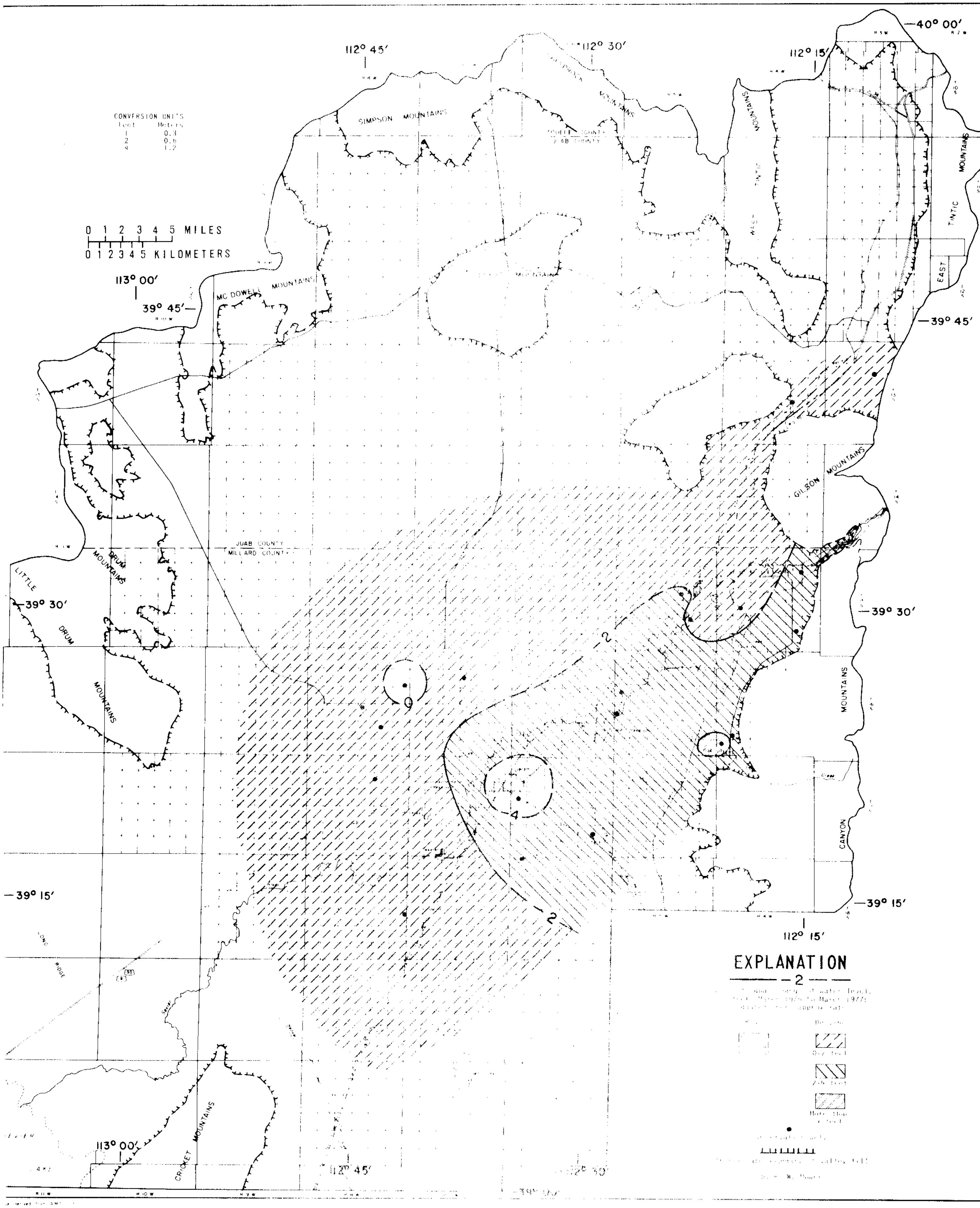


Figure 18.—Map of part of the Sevier Desert showing change of water levels in the lower artesian aquifer from March 1976 to March 1977.

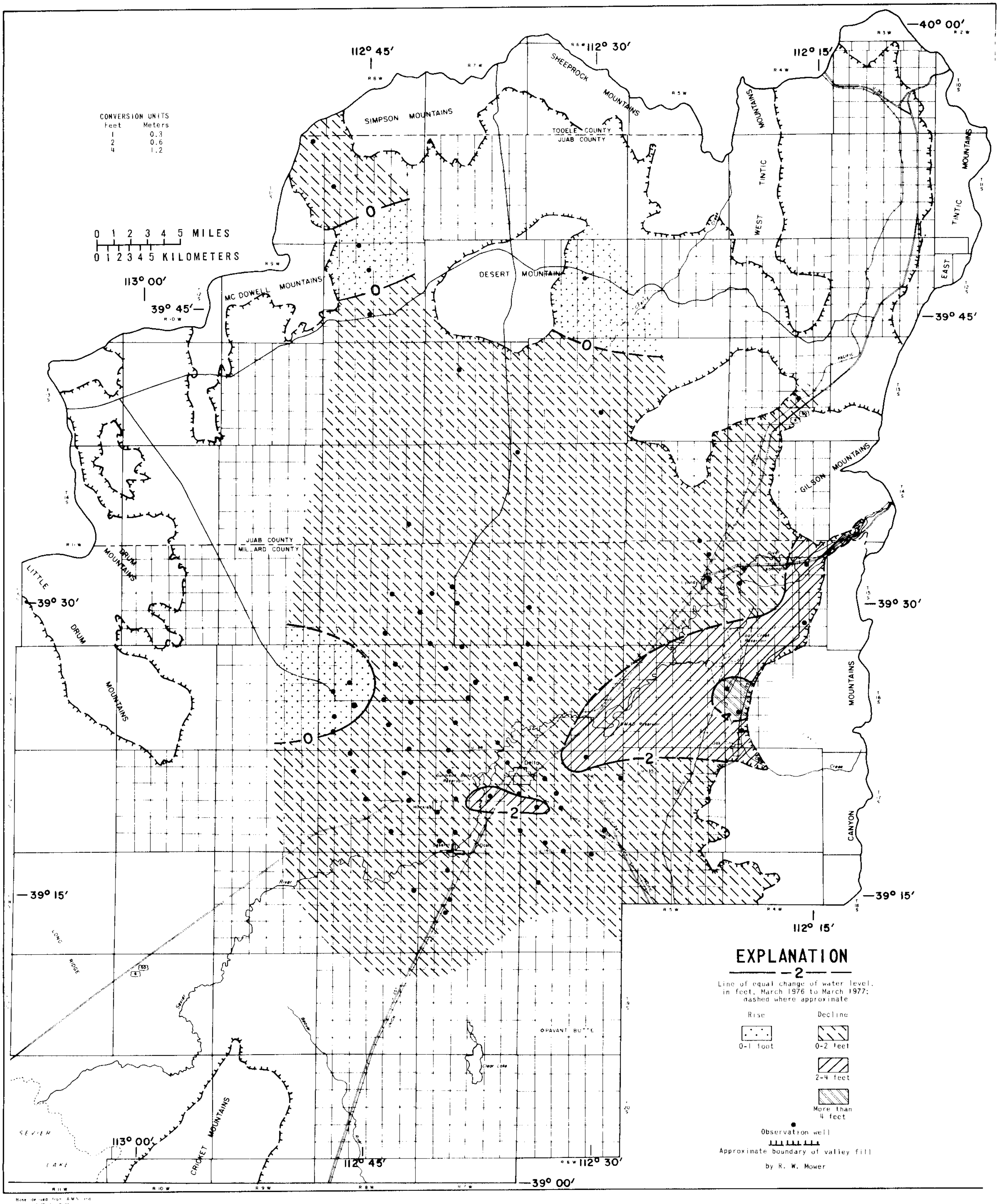


Figure 19.—Map of part of the Sevier Desert showing change of water levels in the upper artesian aquifer from March 1976 to March 1977.

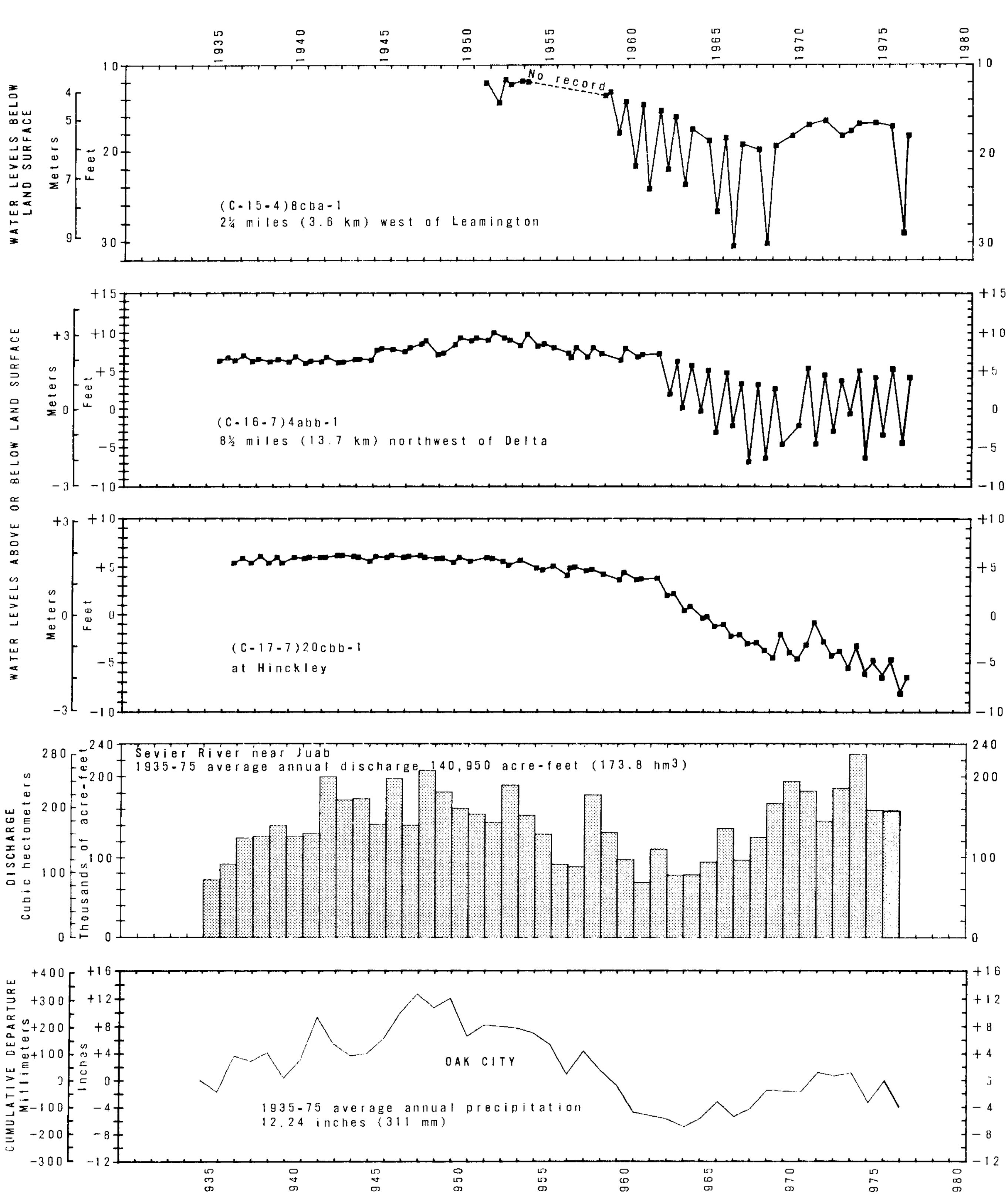


Figure 20.—Relation of water levels in selected wells in the Sevier Desert to discharge of the Sevier River near Juab and to cumulative departure from the average annual precipitation at Oak City.

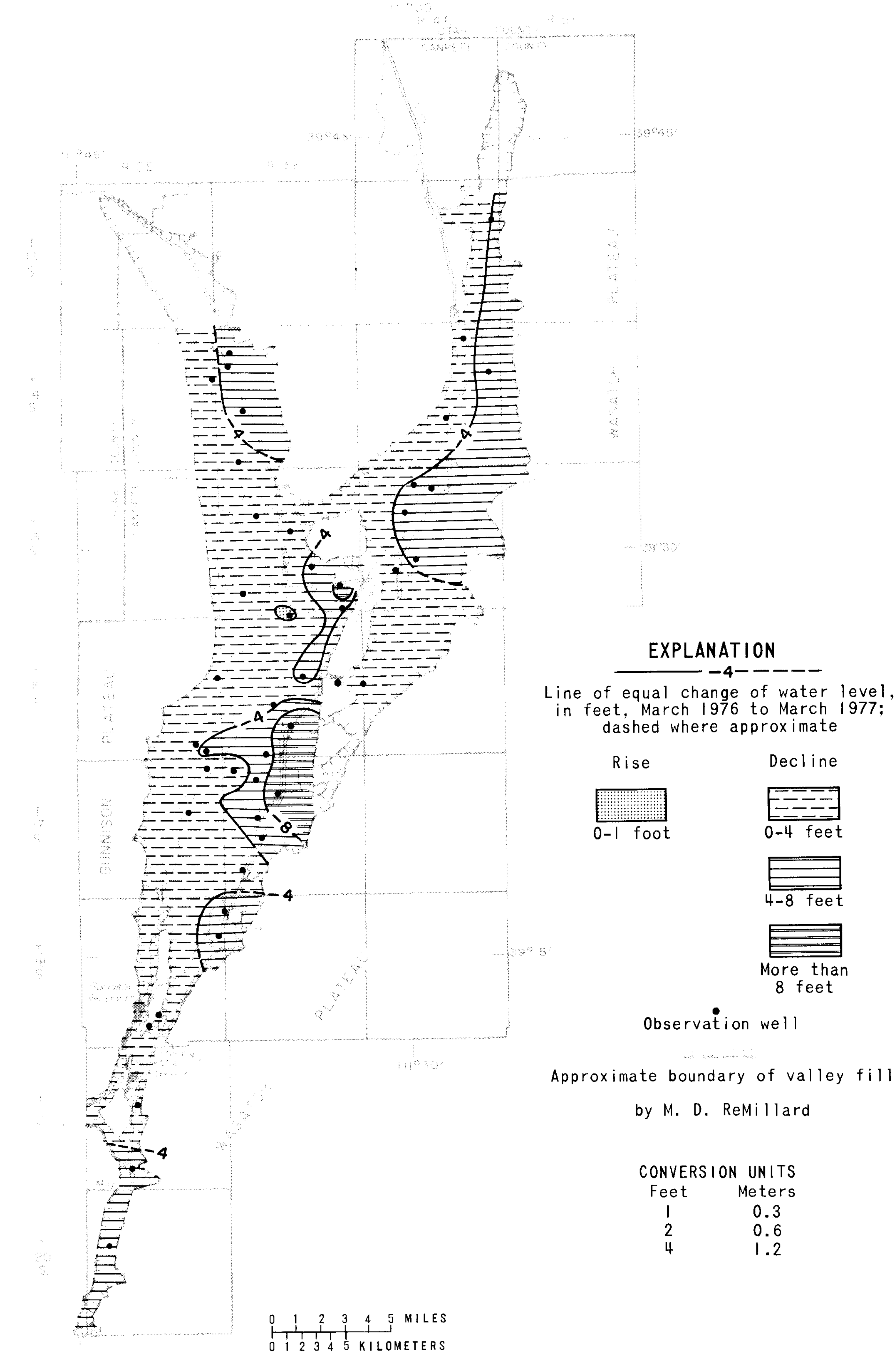


Figure 21.—Map of Sanpete Valley showing change of water levels from March 1976 to March 1977.

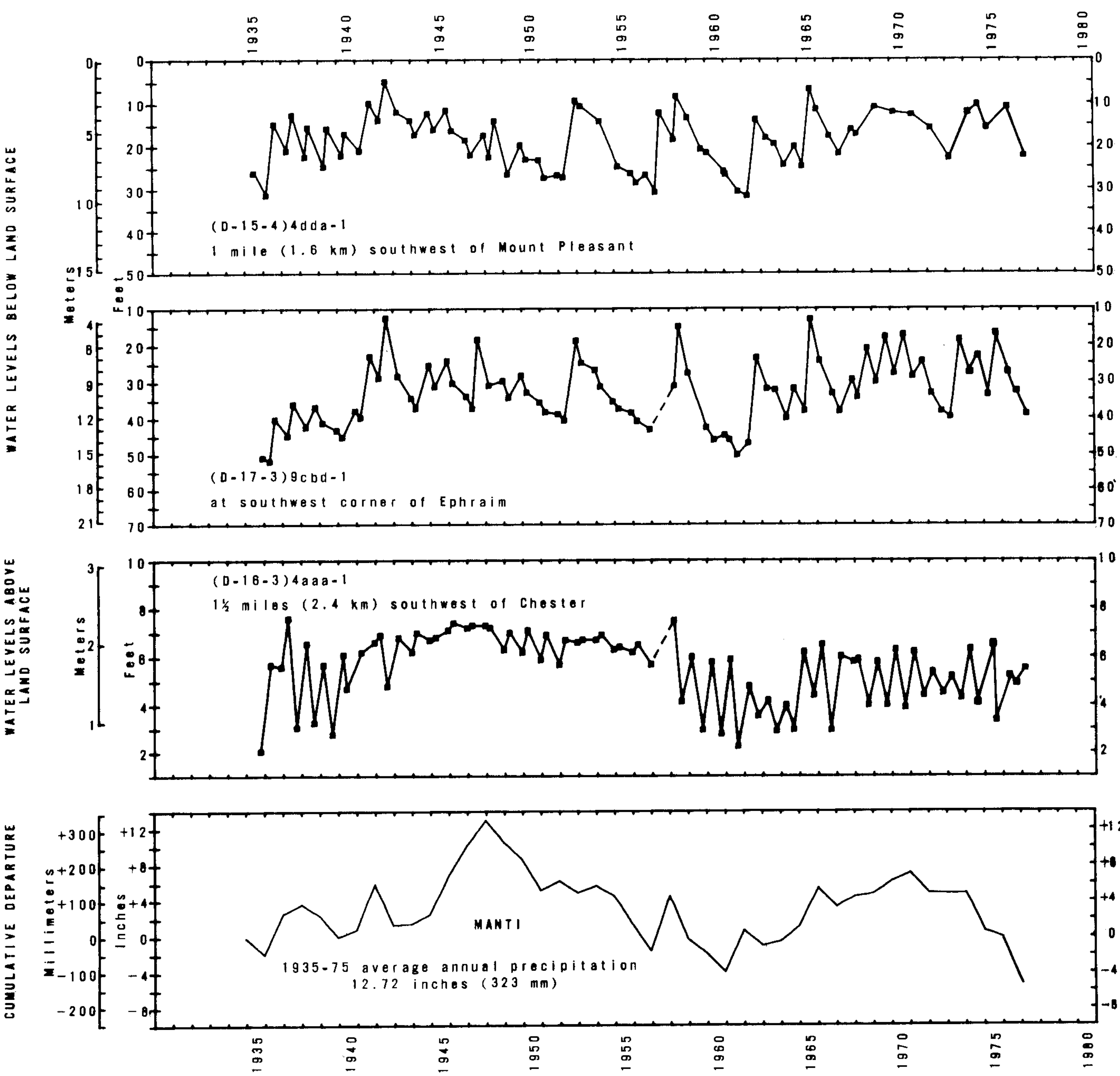
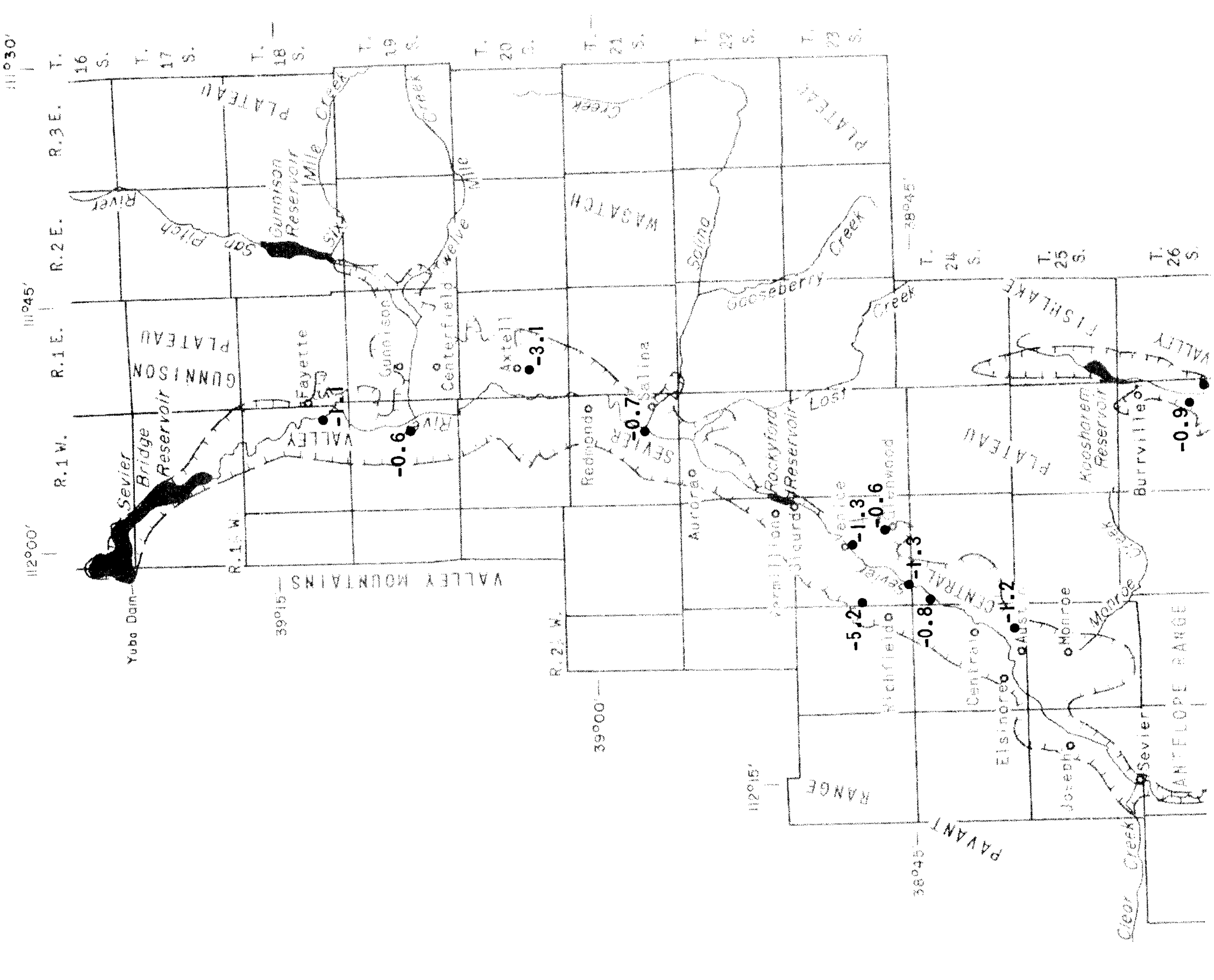


Figure 22.—Relation of water levels in selected wells in Sanpete Valley to cumulative departure from the average annual precipitation at Manti.



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T.17S.
T.18S.
T.19S.
T.20S.
T.21S.
T.22S.
T.23S.
T.24S.
T.25S.
T.26S.
Yuba Dam
Sevier Bridge Reservoir
GUNNISON PLATEAU
VALLEY MOUNTAINS
San Pitch River
Gunnison Reservoir
Six Mile Creek
Twelve Mile Creek
WASATCH PLATEAU
Salina Creek
Gooseberry Creek
Lost Creek
Fayette
Gunnison
Centerfield
Axtell
Salina
Redmond
Aurora
SEVIER VALLEY
Sevier River
Rockyford Reservoir
Sigurd
Venice
Glenwood
Richfield
Elsinore
Joseph
Monroe
Austin
Sevier
CENTRAL
FISHLAKE PLATEAU
Koosharem Reservoir
Burrville
Monroe Creek
ANTELOPE RANGE
PAVANT RANGE
Clear Creek
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-1.2
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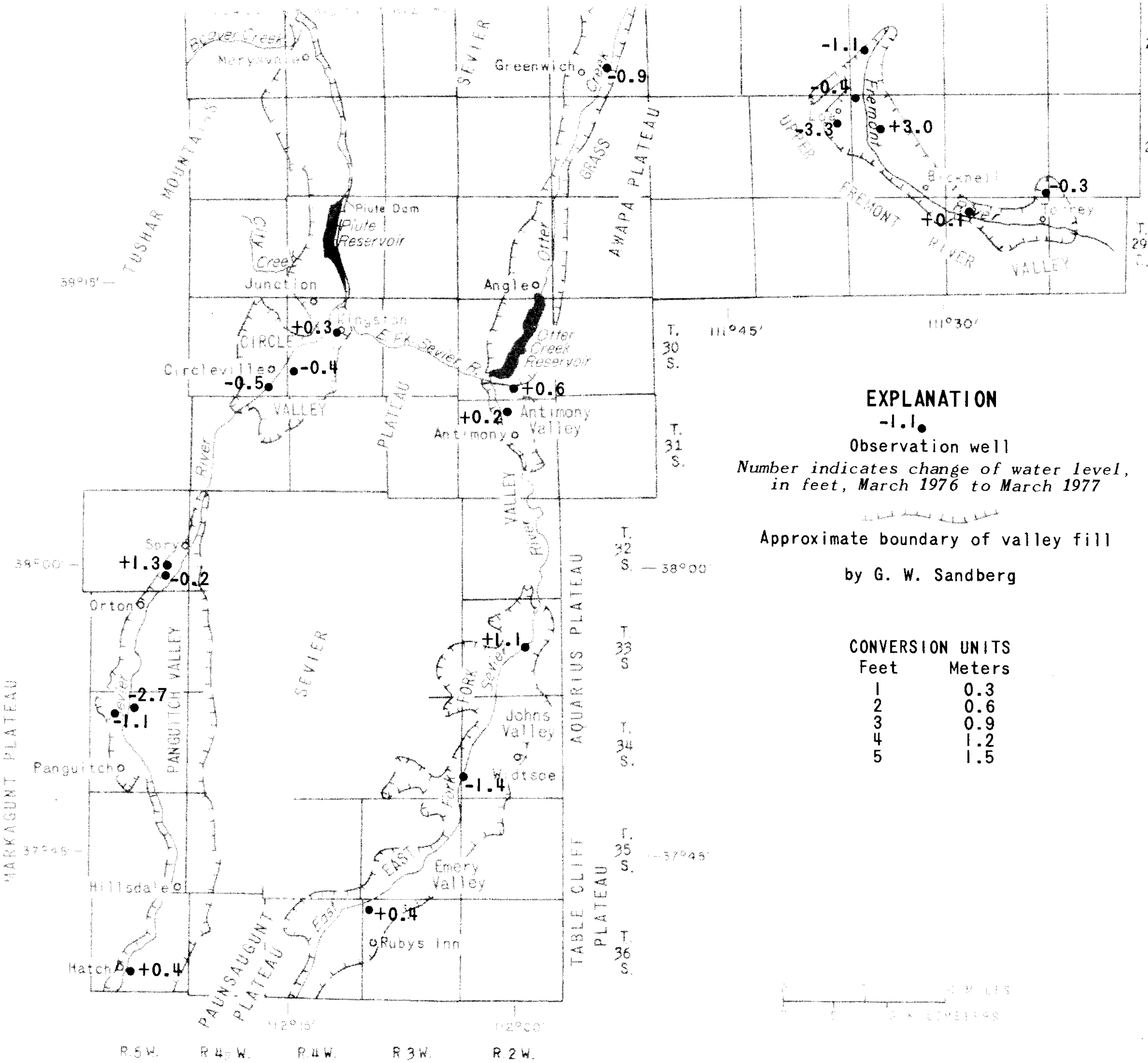


Figure 23.—Map of the upper and central Sevier and upper Fremont River Valleys showing change of water levels from March 1976 to March 1977.

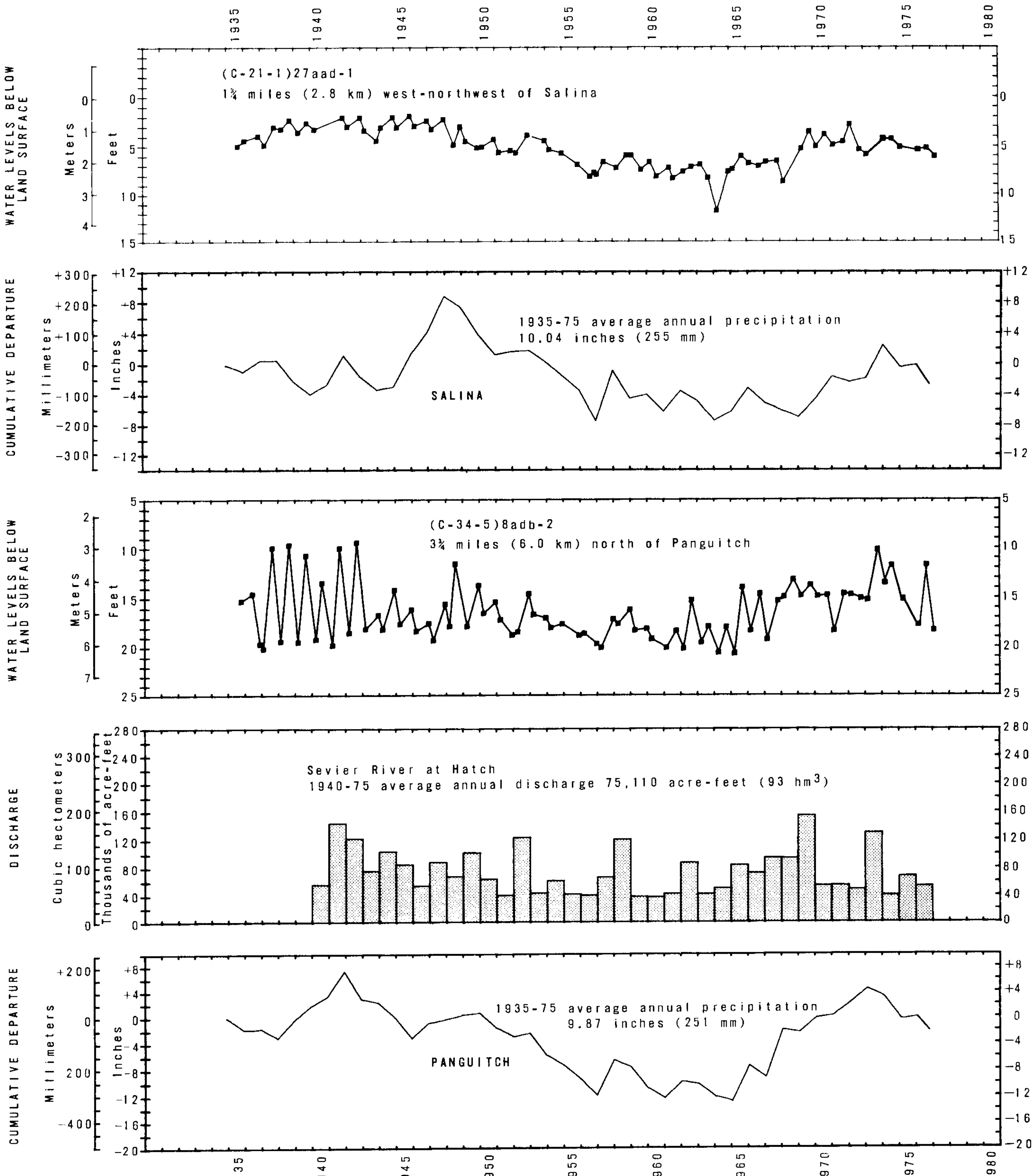
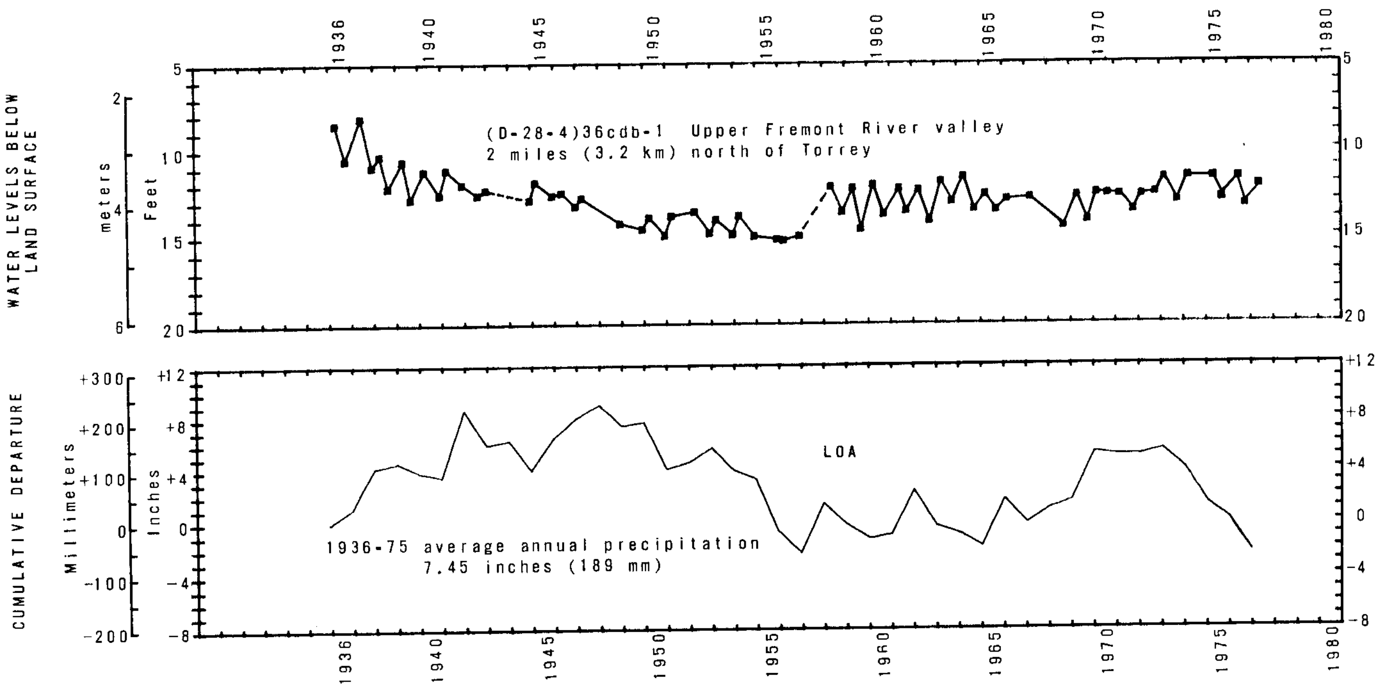


Figure 24.—Relation of water levels in selected wells in the upper and central Sevier Valleys to discharge of the Sevier River at Hatch and to cumulative departure from the average annual precipitation at Salina and Panguitch and relation of the water level in well (D-28-4)36cdb-1 to cumulative departure from the average annual precipitation at Loa.



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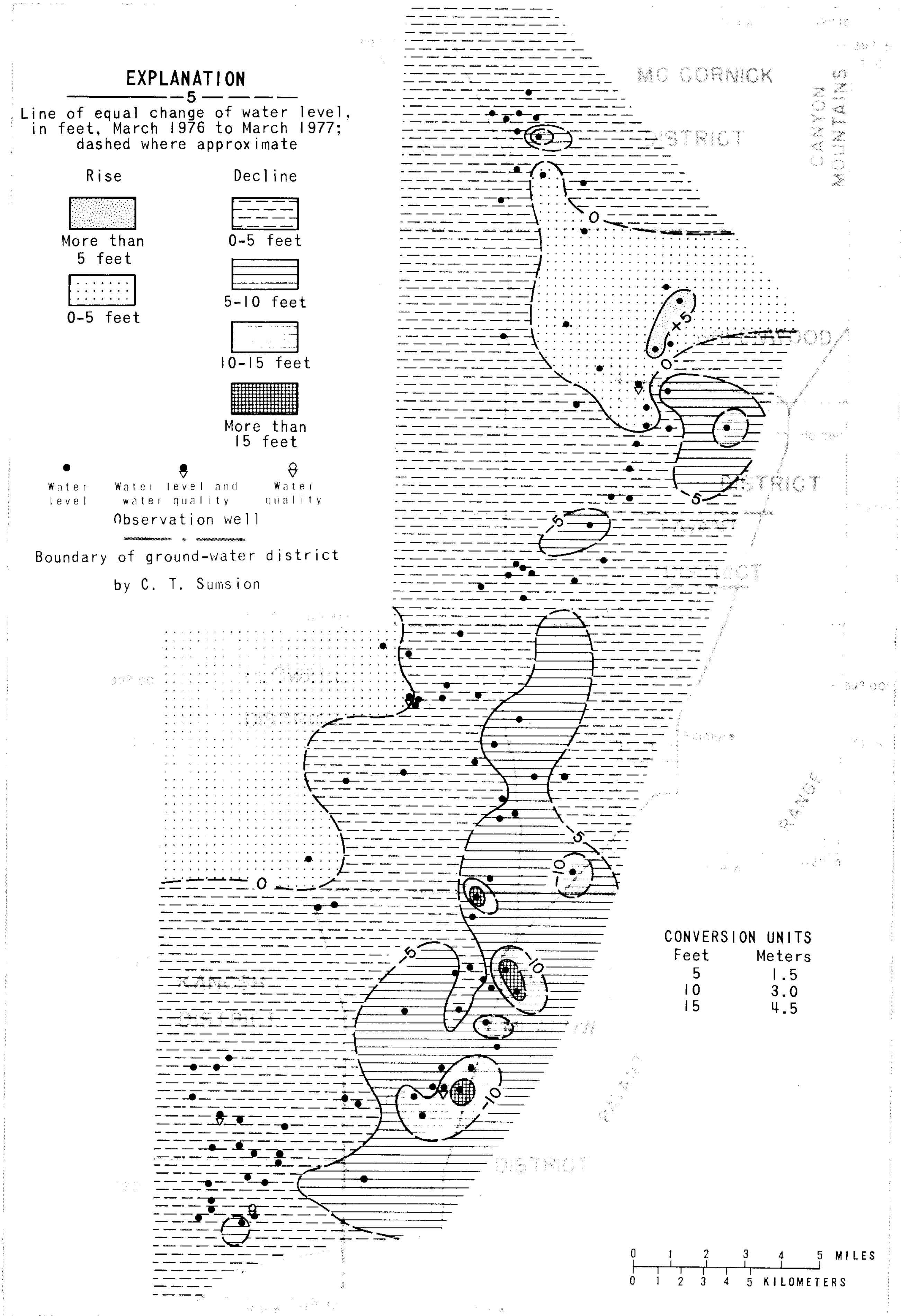


Figure 25.—Map of Pavant Valley showing change of water levels from March 1976 to March 1977.

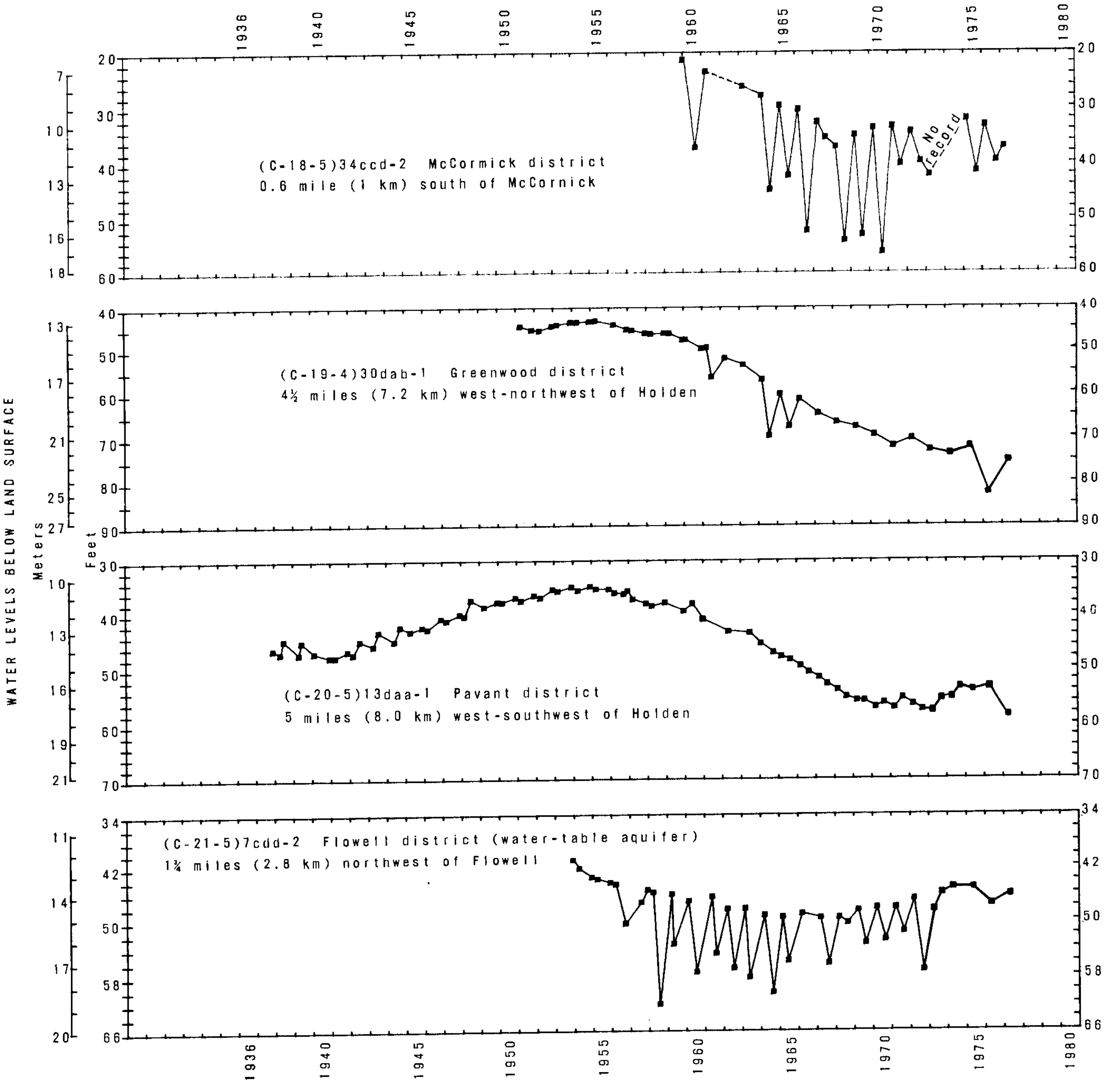
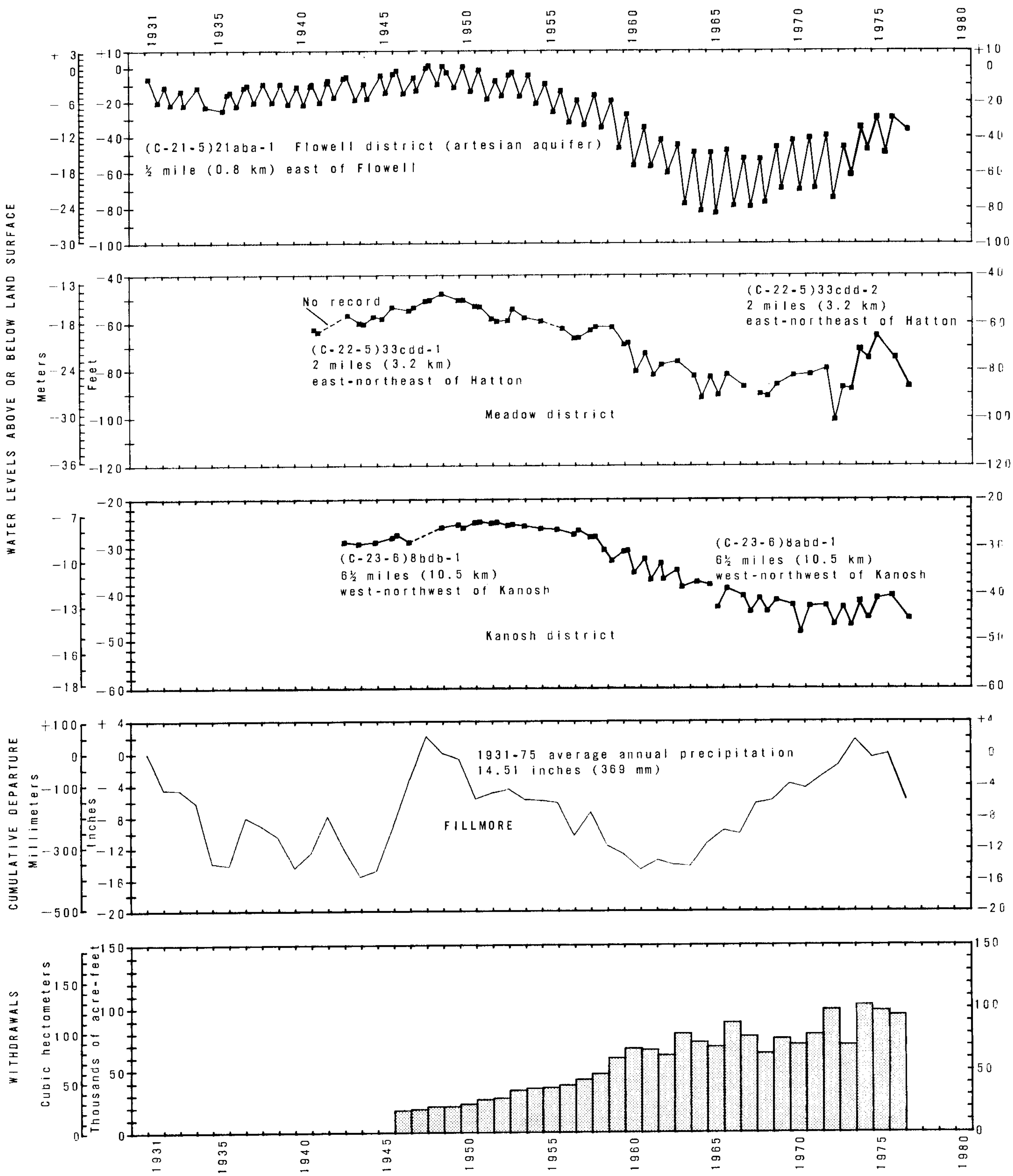


Figure 26.—Relation of water levels in selected wells in Pavant Valley to cumulative departure from the average annual precipitation at Fillmore and to total withdrawals from wells.



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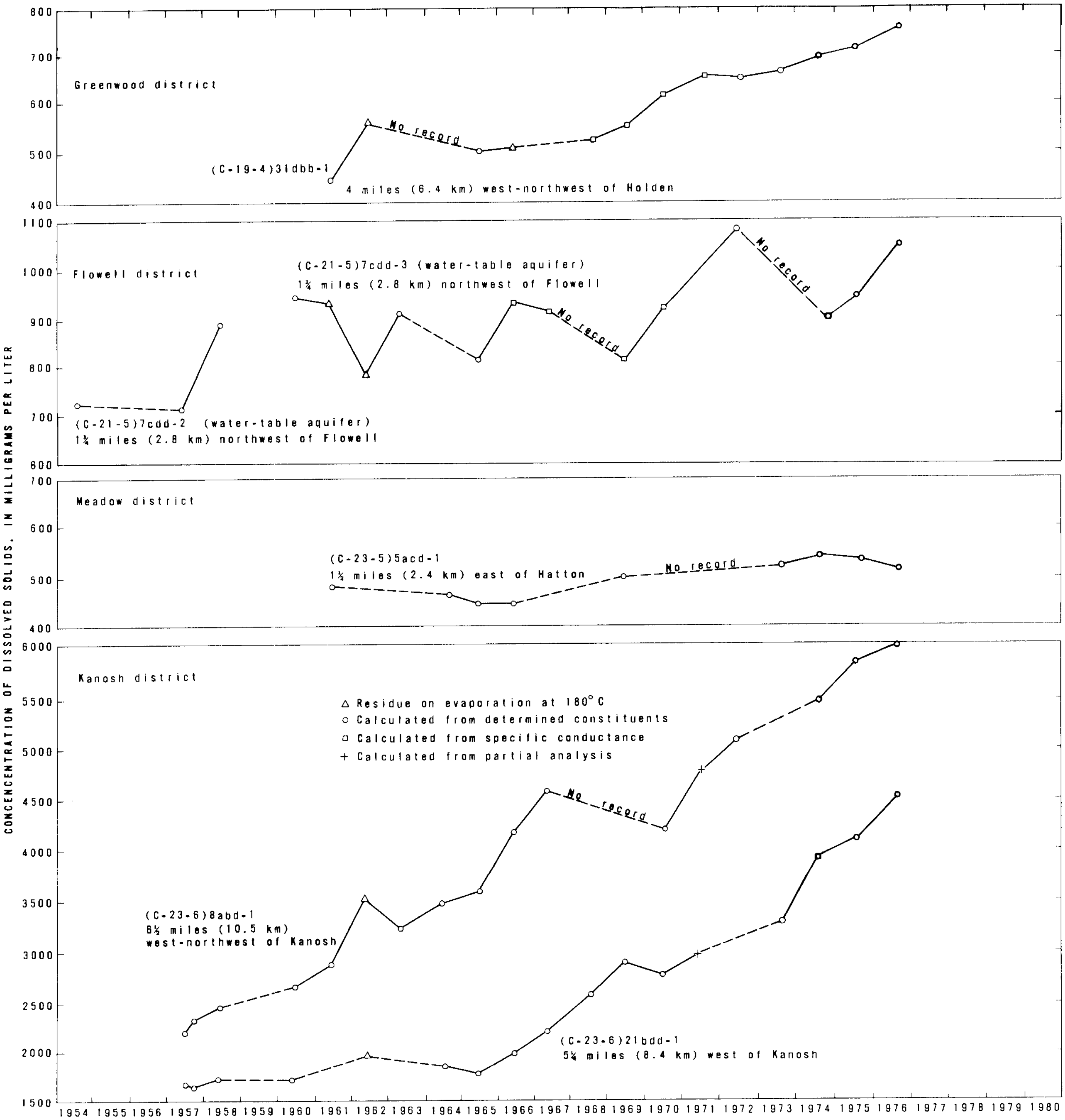

Figure 27.— Concentration of dissolved solids in water from selected wells in Pavant Valley.

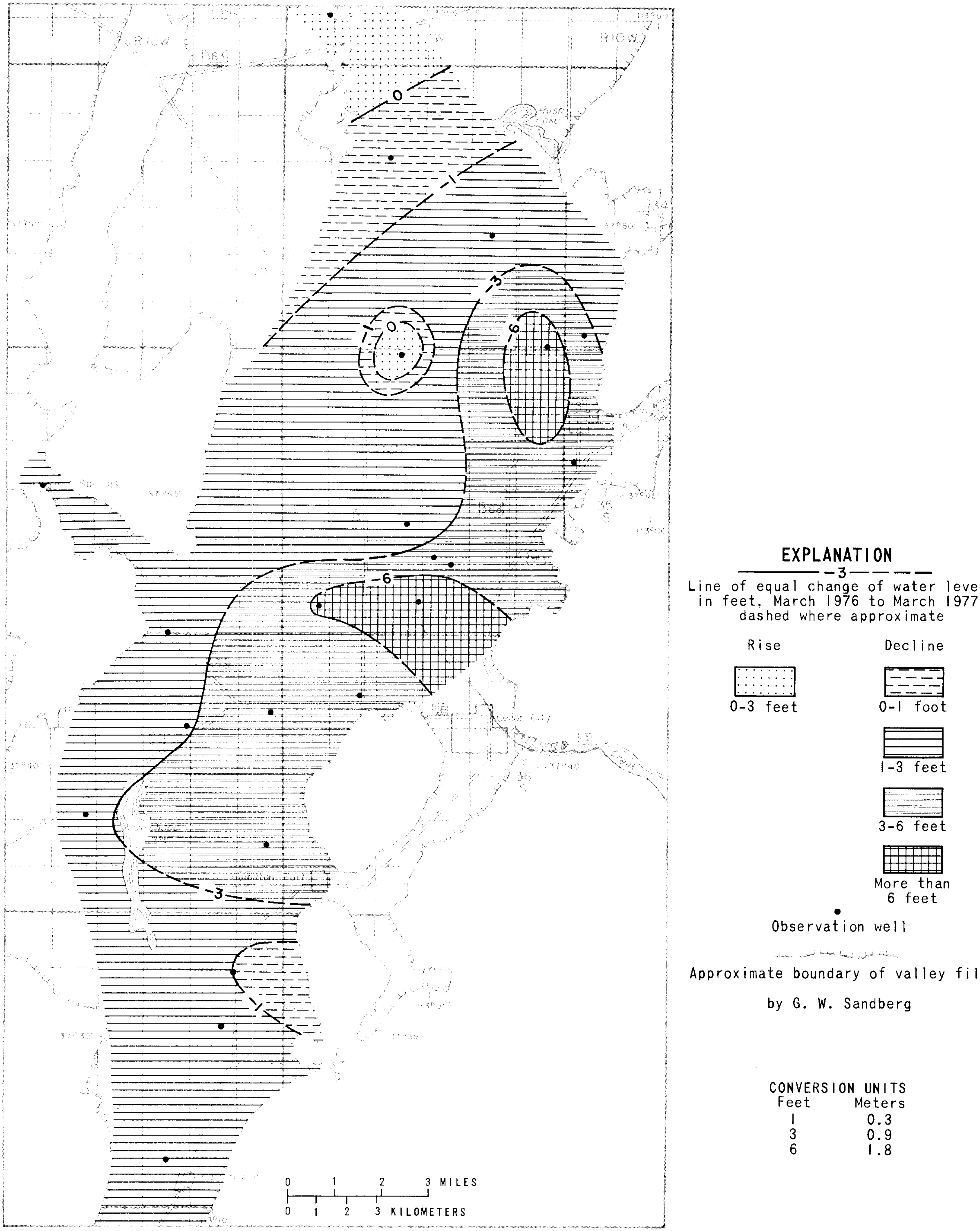

Figure 28.—Map of Cedar City Valley showing change of water levels from March 1976 to March 1977.

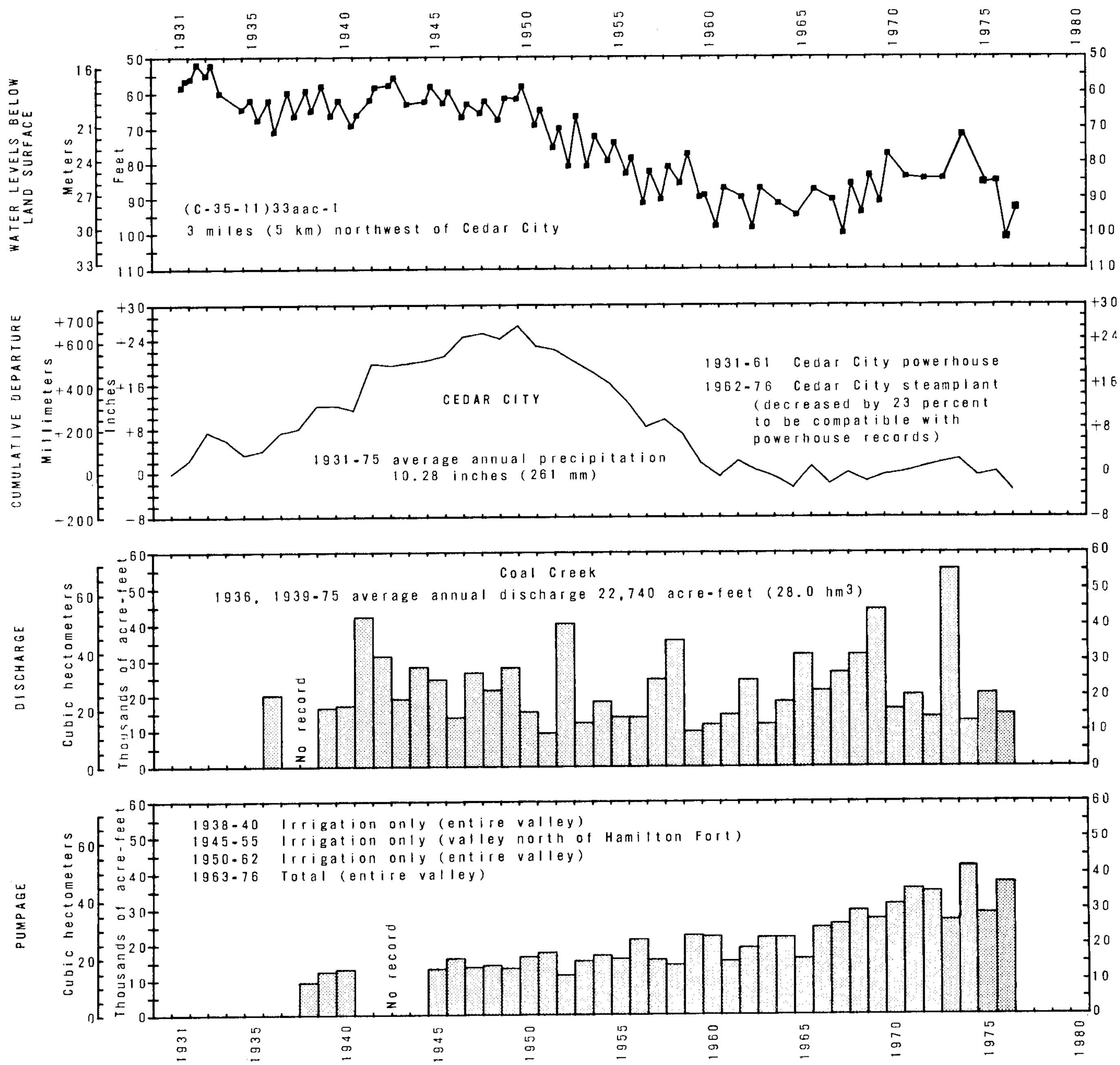

Figure 29.—Relation of water levels in well (C-35-11)33aac-1 in Cedar City Valley to cumulative departure from the average annual precipitation at the Cedar City powerhouse, to discharge of Coal Creek near Cedar City, and to pumpage from wells.

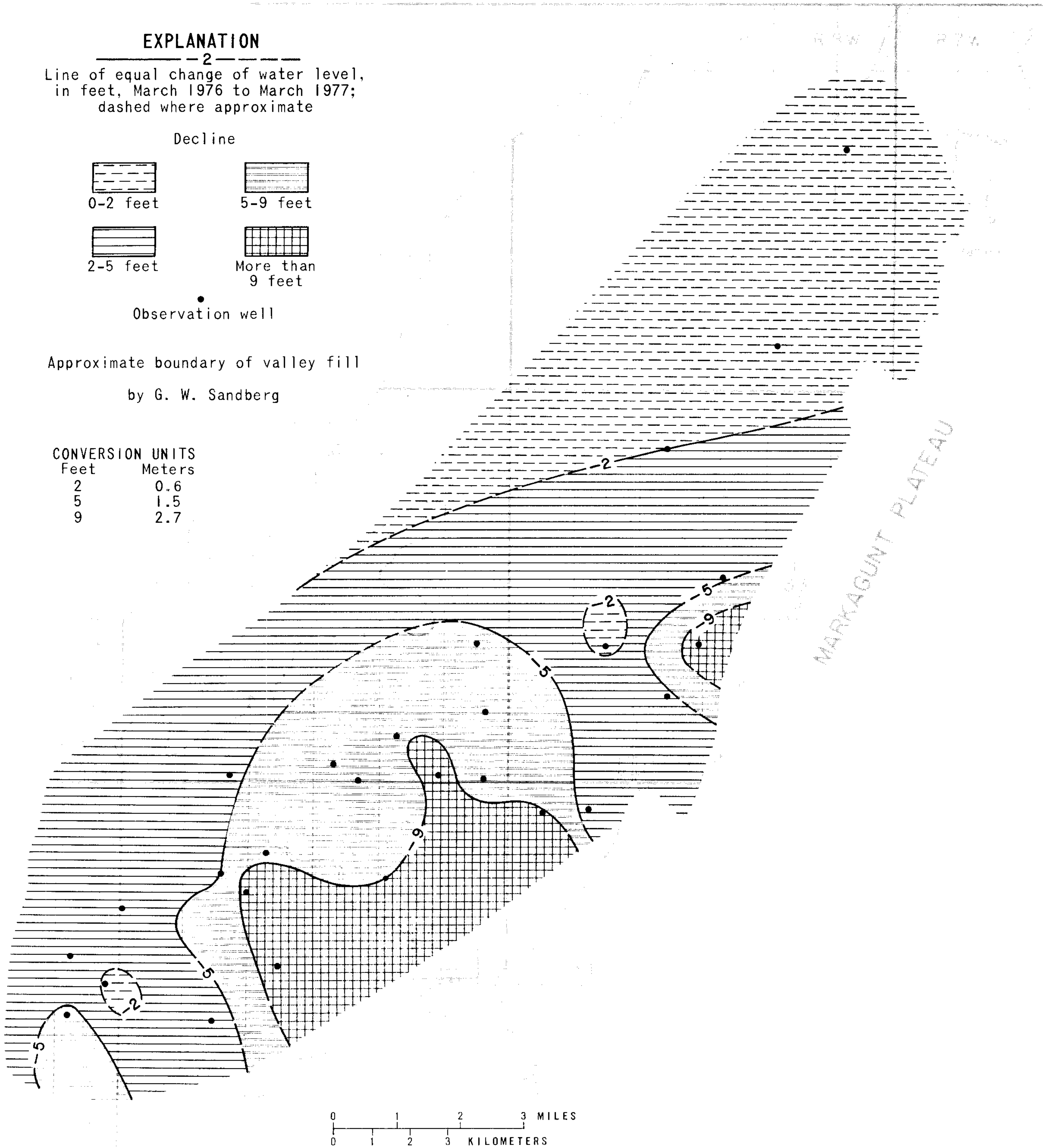

Figure 30.—Map of Parowan Valley showing change of water levels from March 1976 to March 1977.

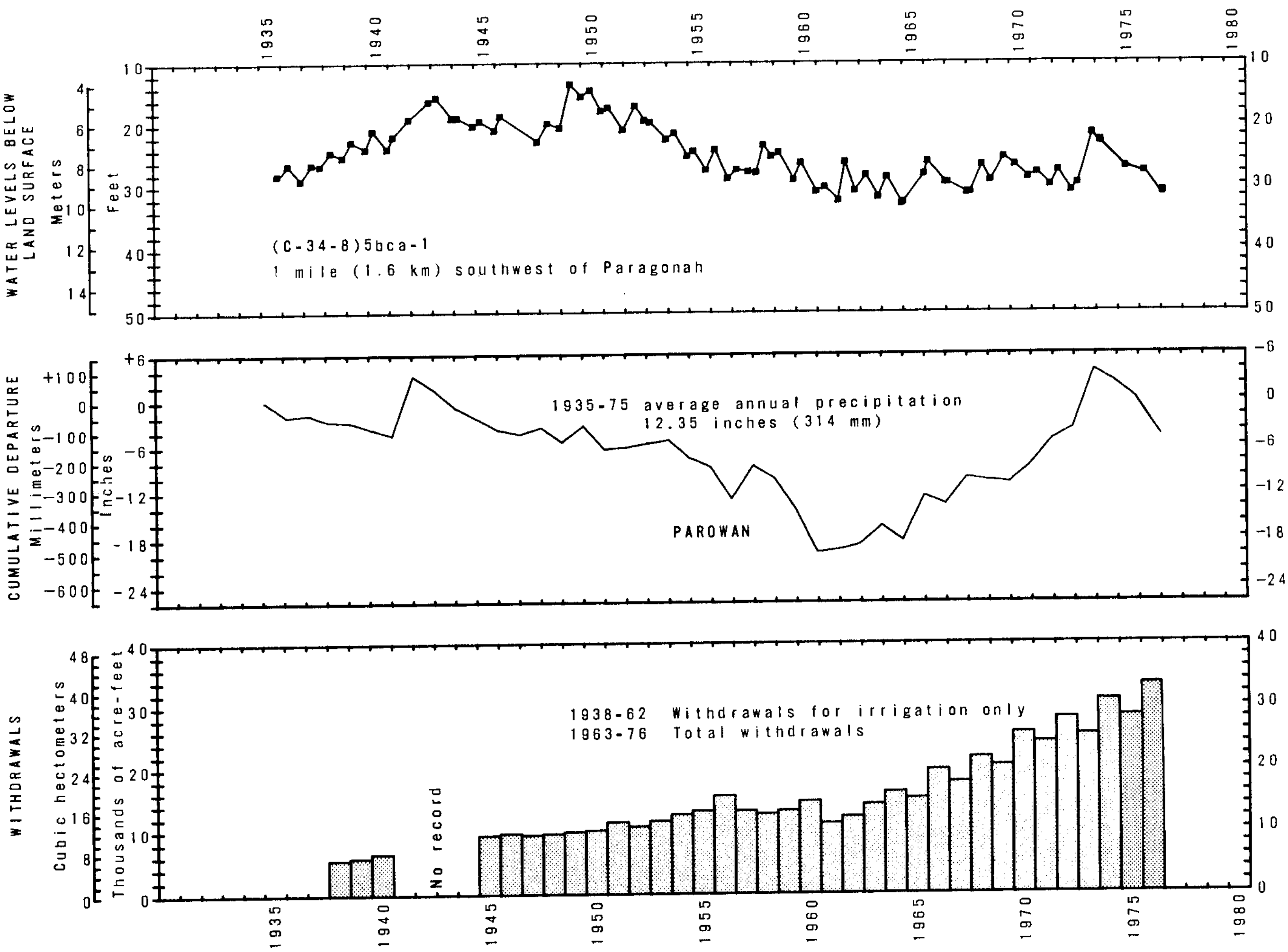

Figure 31.— Relation of water levels in well (C-34-8)5bca-1 in Parowan Valley to cumulative departure from the average annual precipitation at Parowan and to withdrawals from wells.

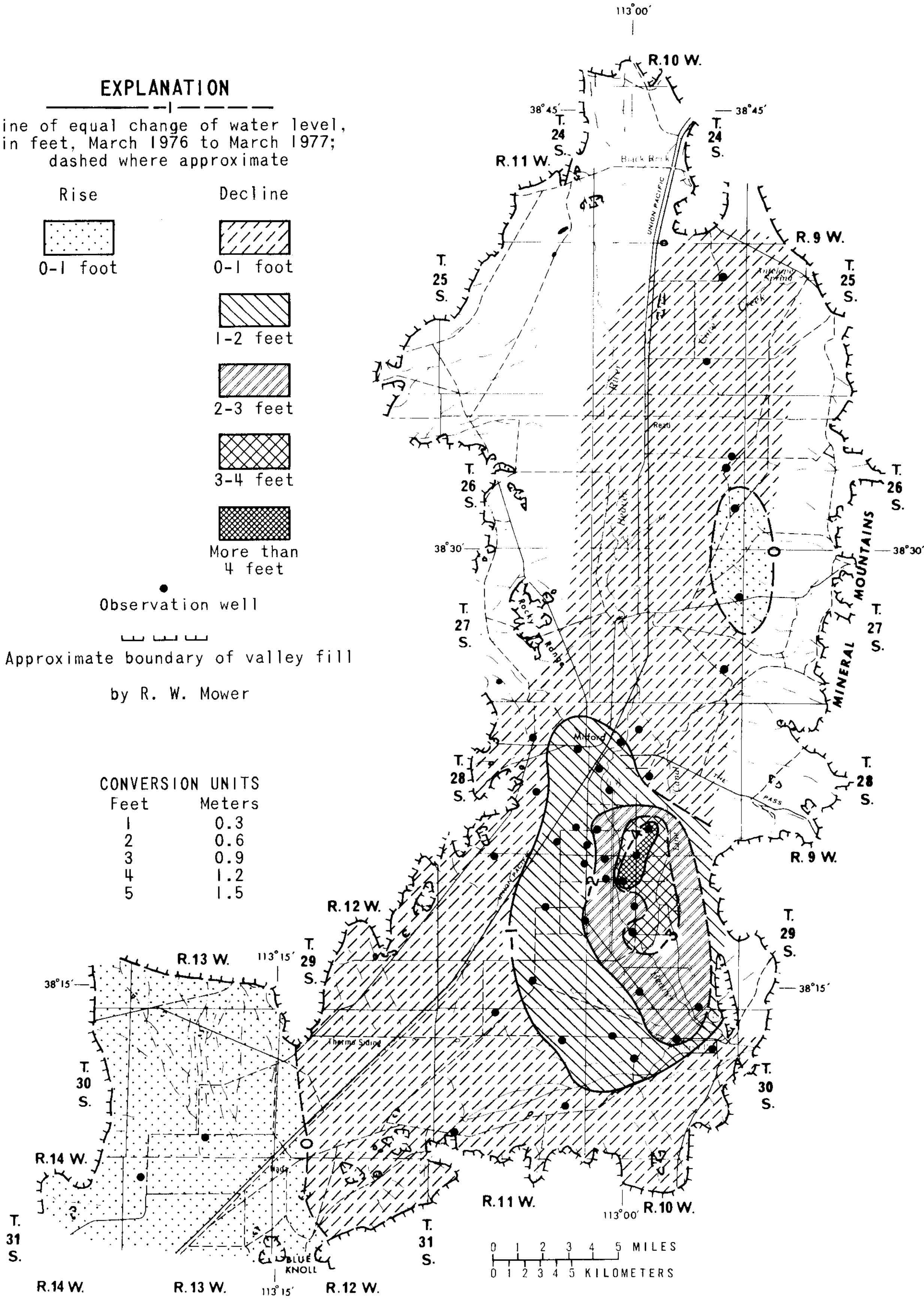

Figure 32.—Map of the Milford area, Escalante Valley, showing change of water levels from March 1976 to March 1977.

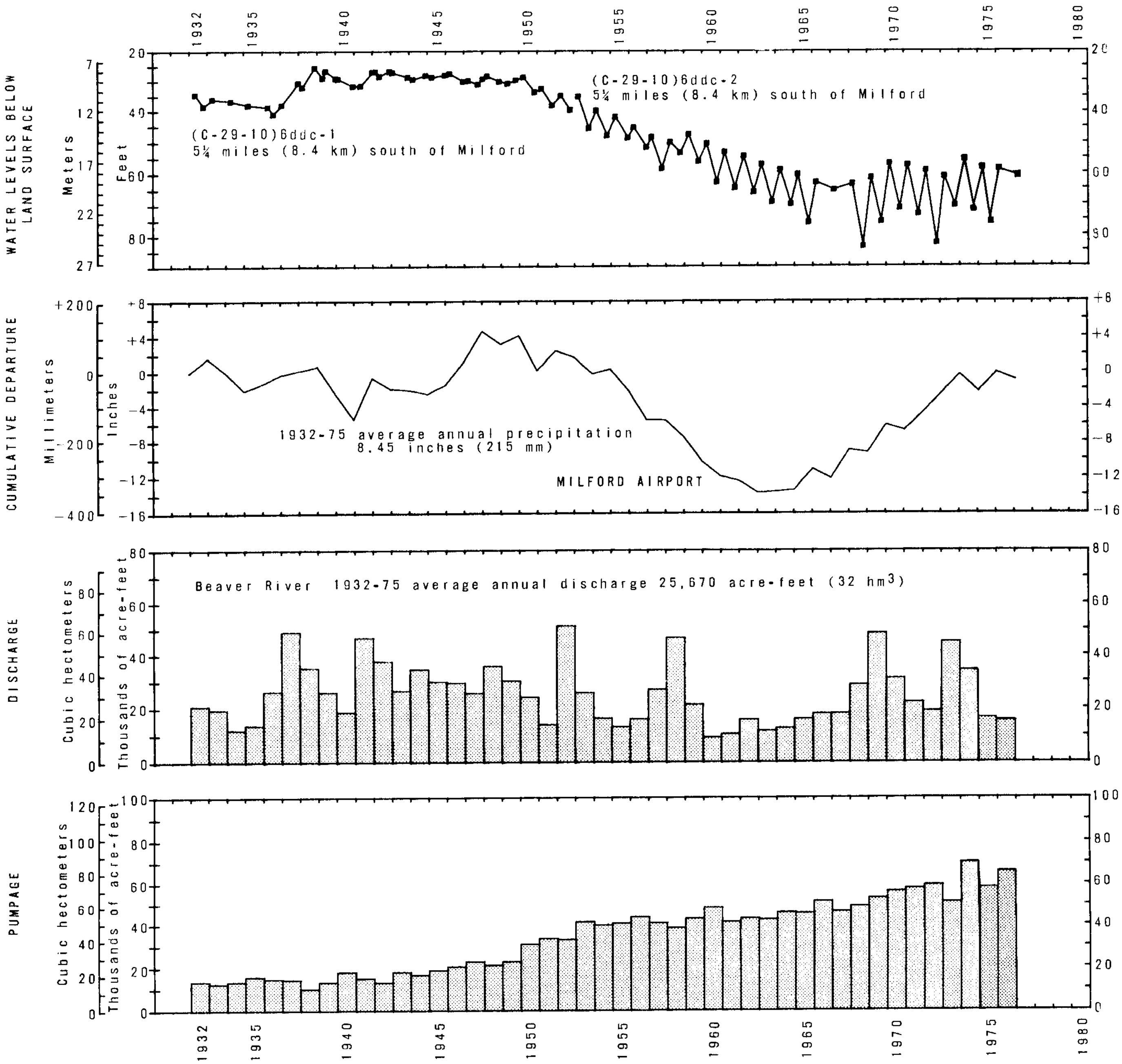

Figure 33.— Relation of water levels in selected wells in the Milford area, Escalante Valley, to cumulative departure from the average annual precipitation at Milford airport, to discharge of the Beaver River at Rockyford Dam near Minersville, and to pumpage for irrigation.

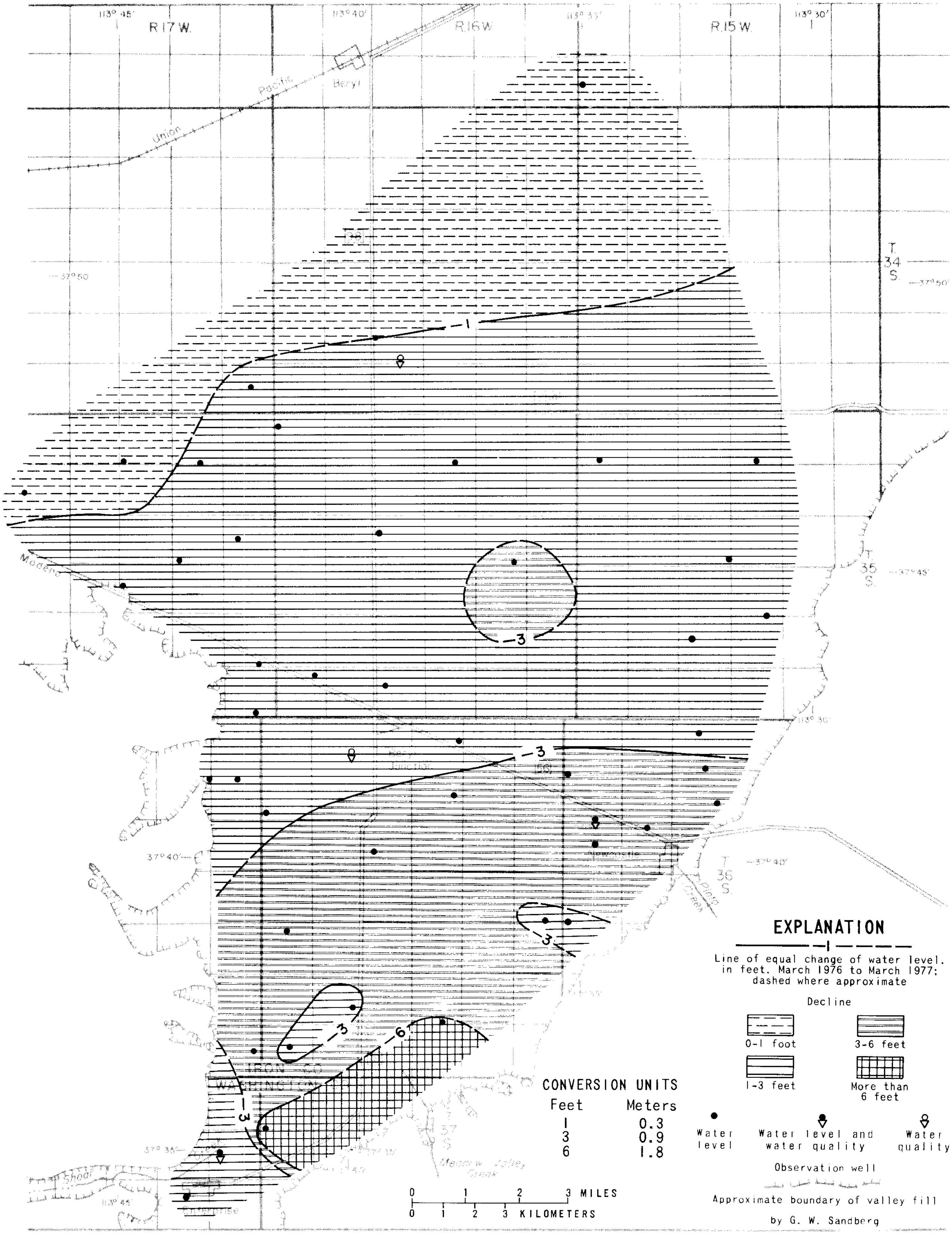

Figure 34.—Map of the Beryl-Enterprise area, Escalante Valley, showing change of water levels from March 1976 to March 1977.

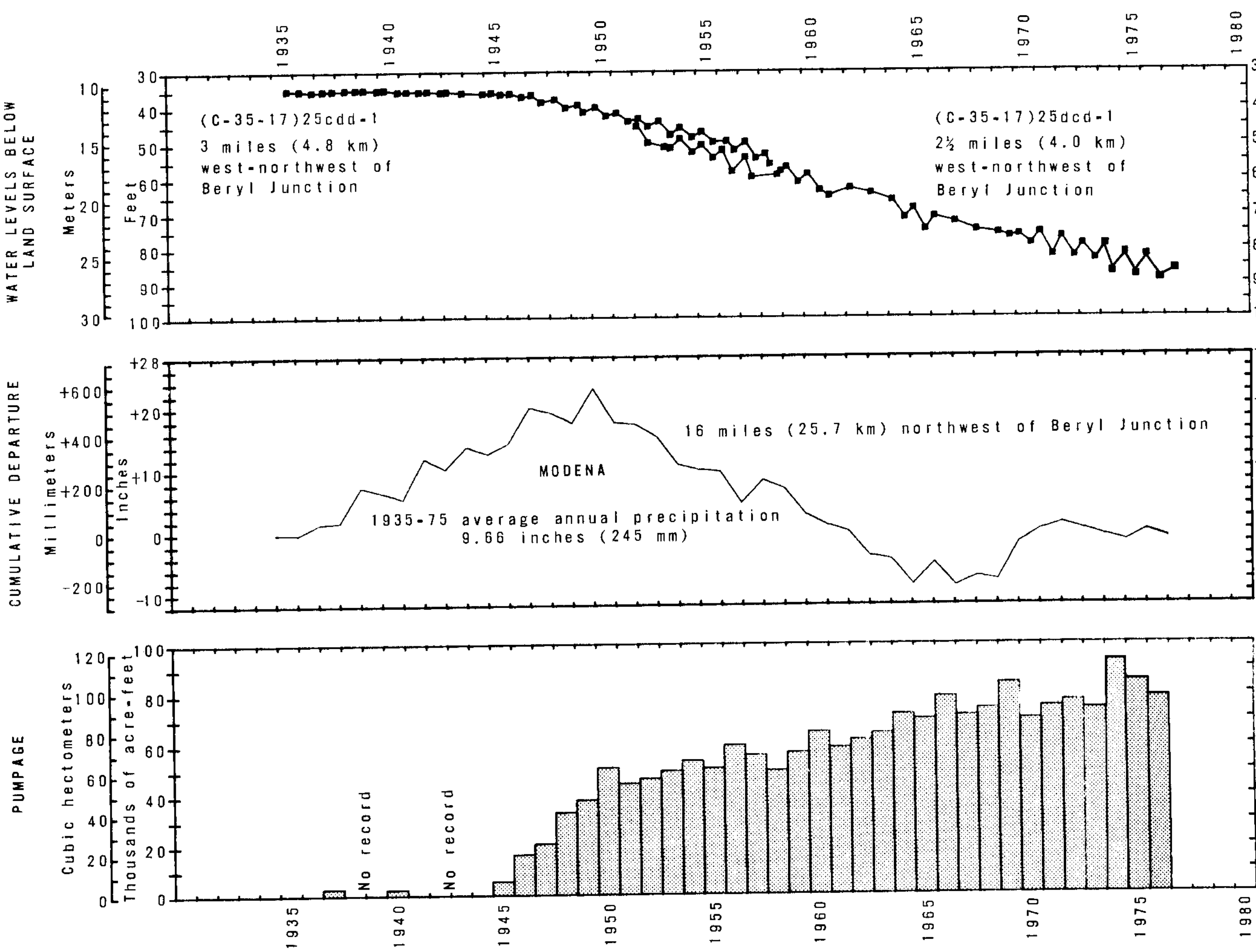

Figure 35.— Relation of water levels in selected wells in the Beryl-Enterprise area, Escalante Valley, to cumulative departure from the average annual precipitation at Modena and to pumpage for irrigation.

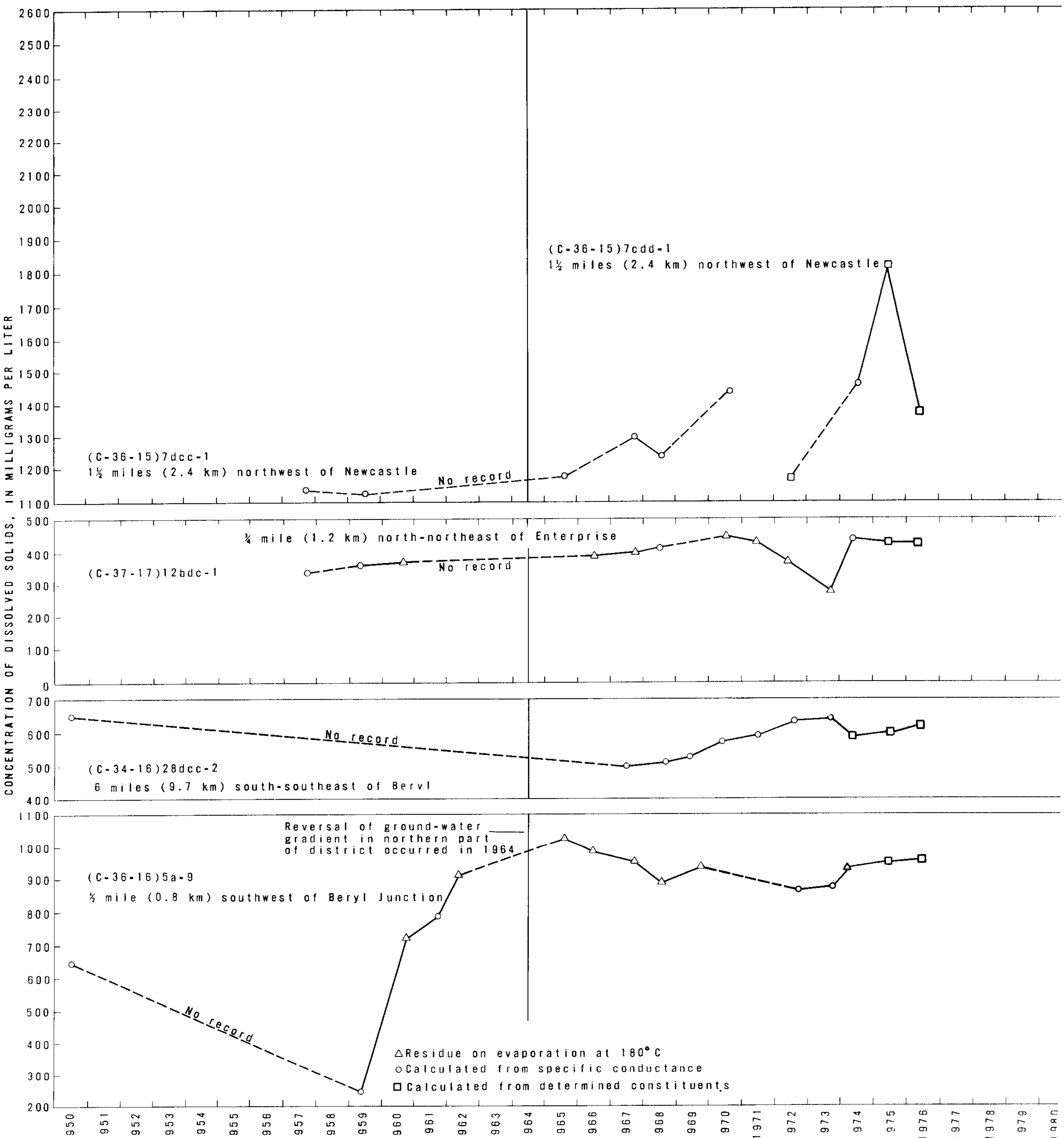

Figure 36.— Concentration of dissolved solids in water from selected wells in the Beryl-Enterprise area, Escalante Valley.

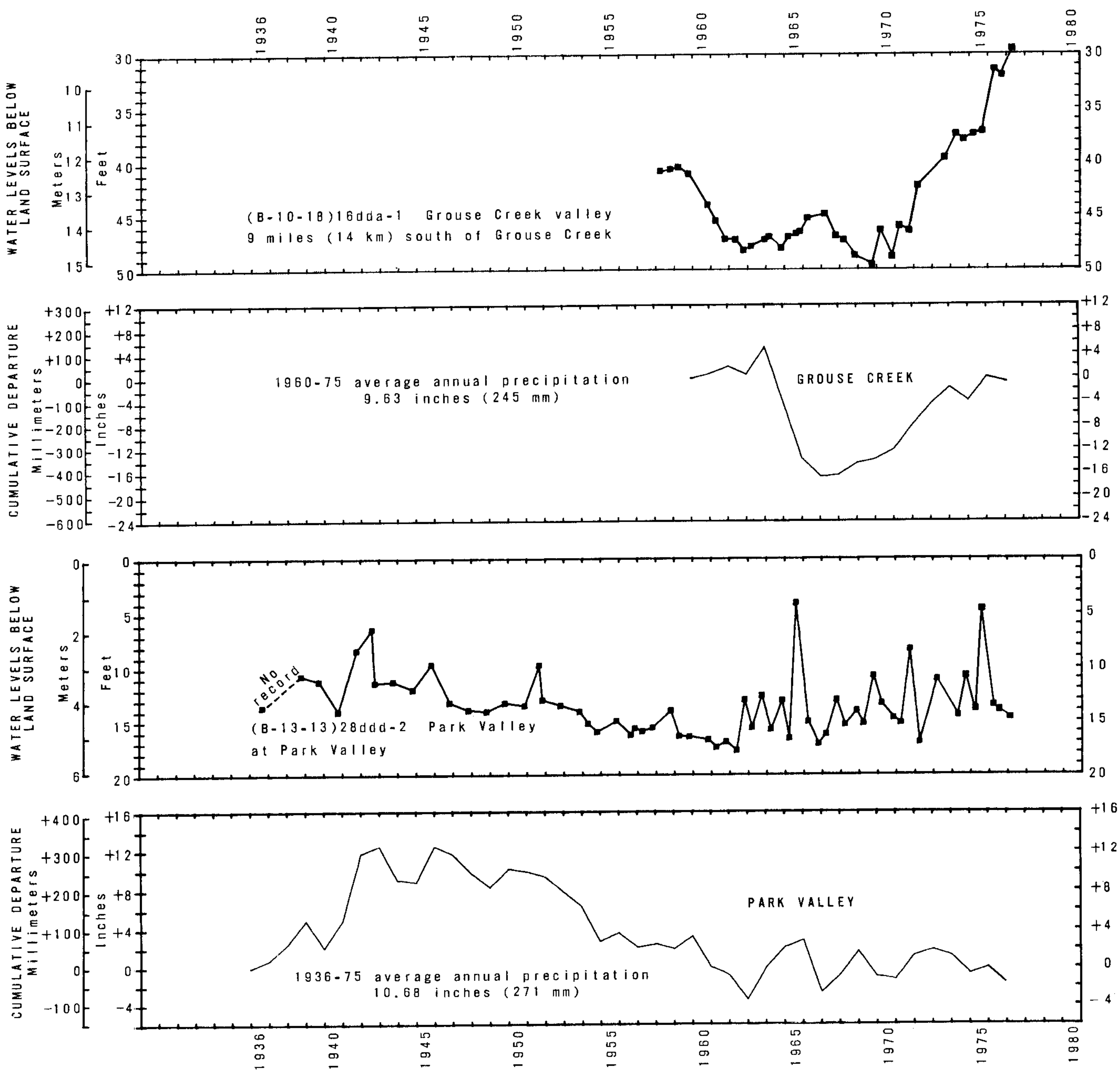

Figure 37.—Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas.

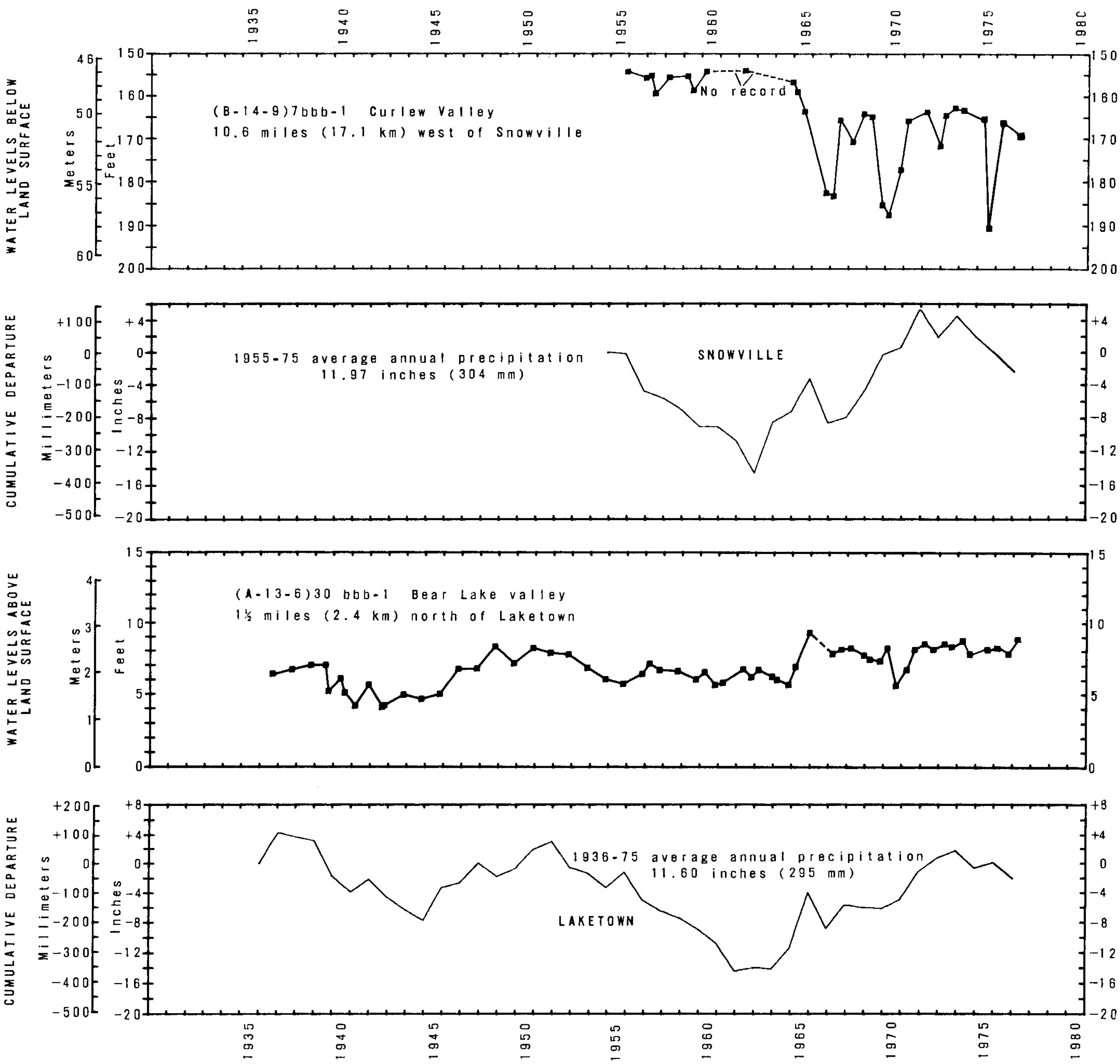

Figure 37.— Continued.

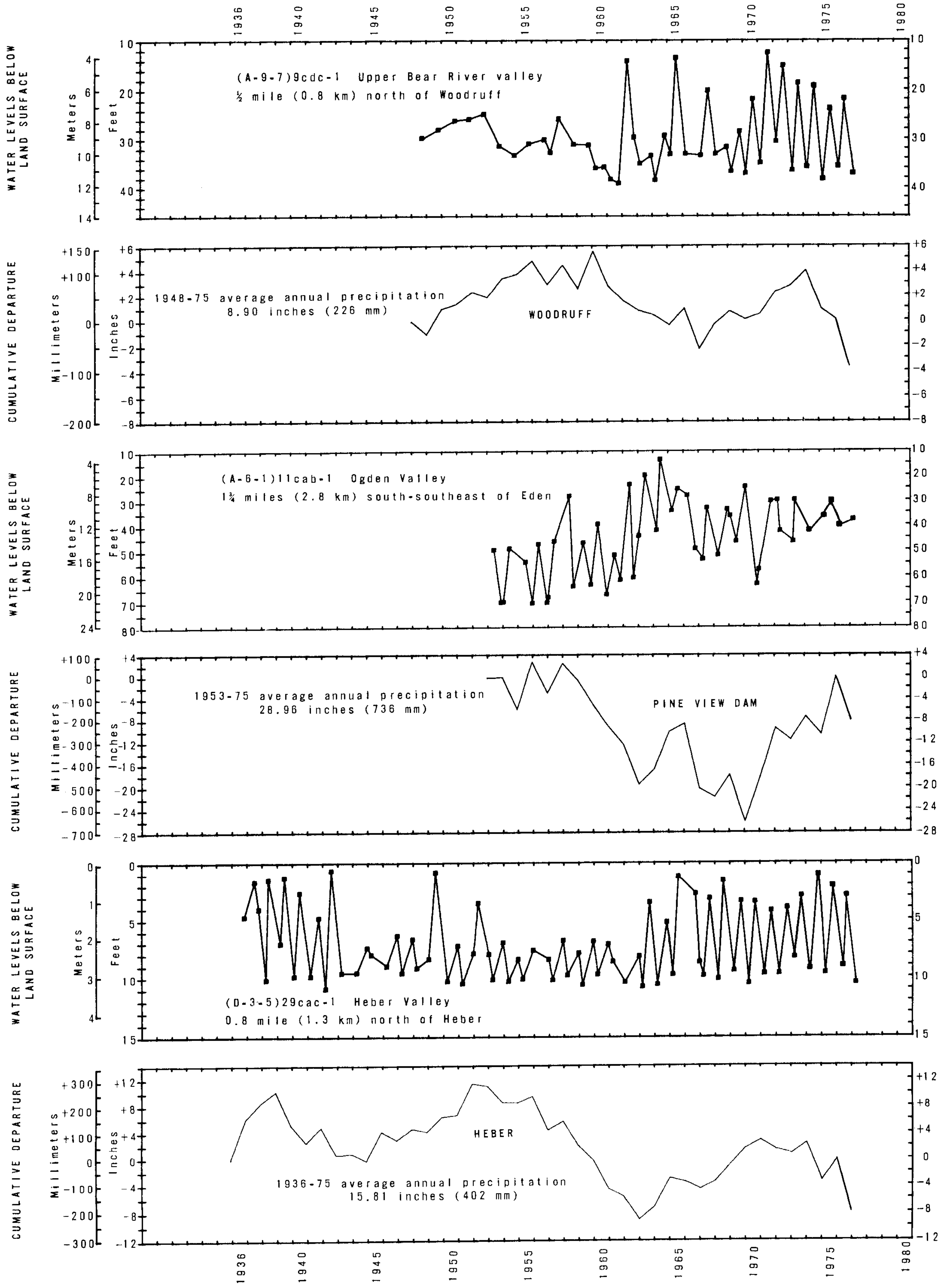

Figure 37.— Continued.

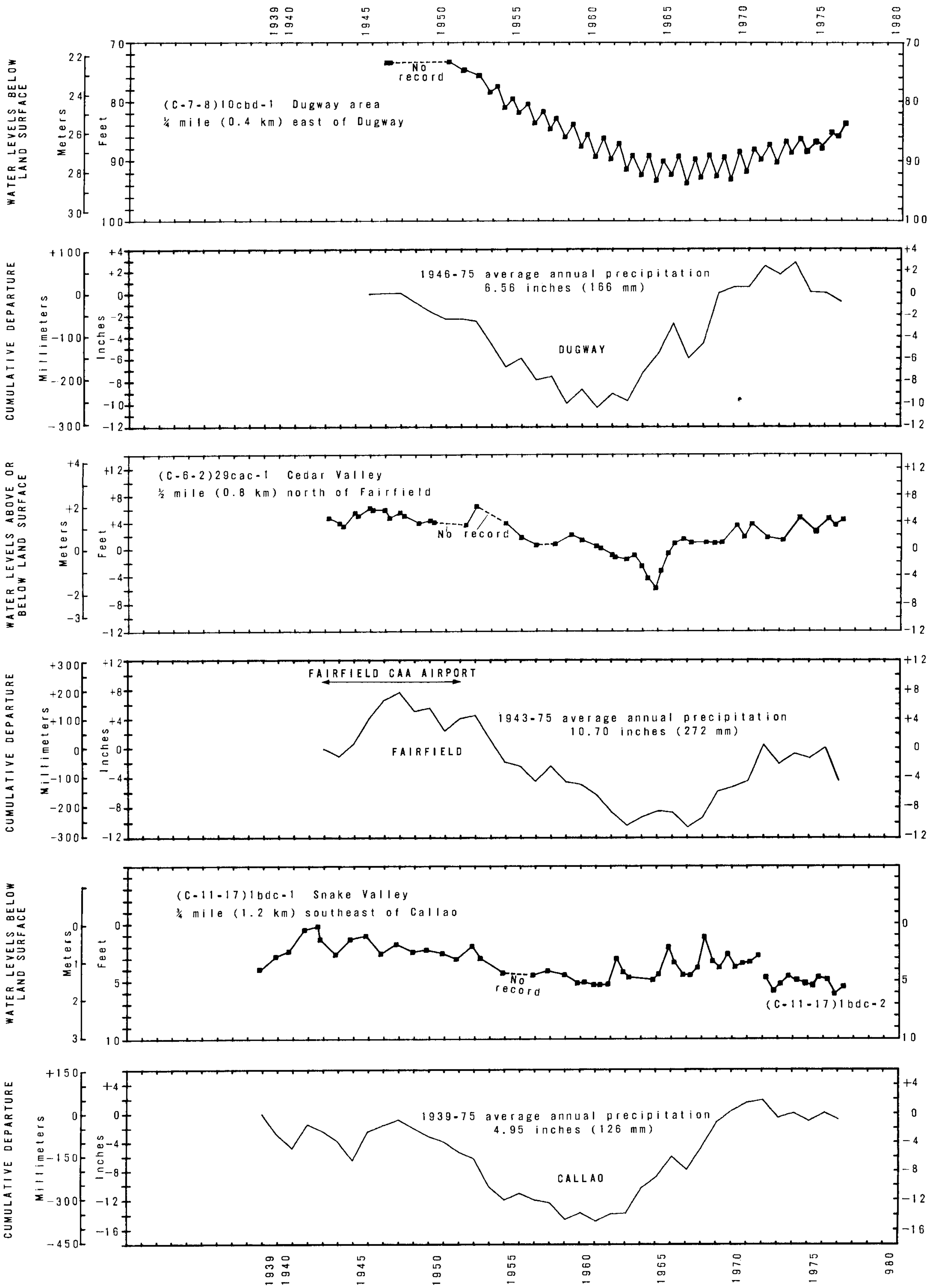

Figure 37.— Continued.

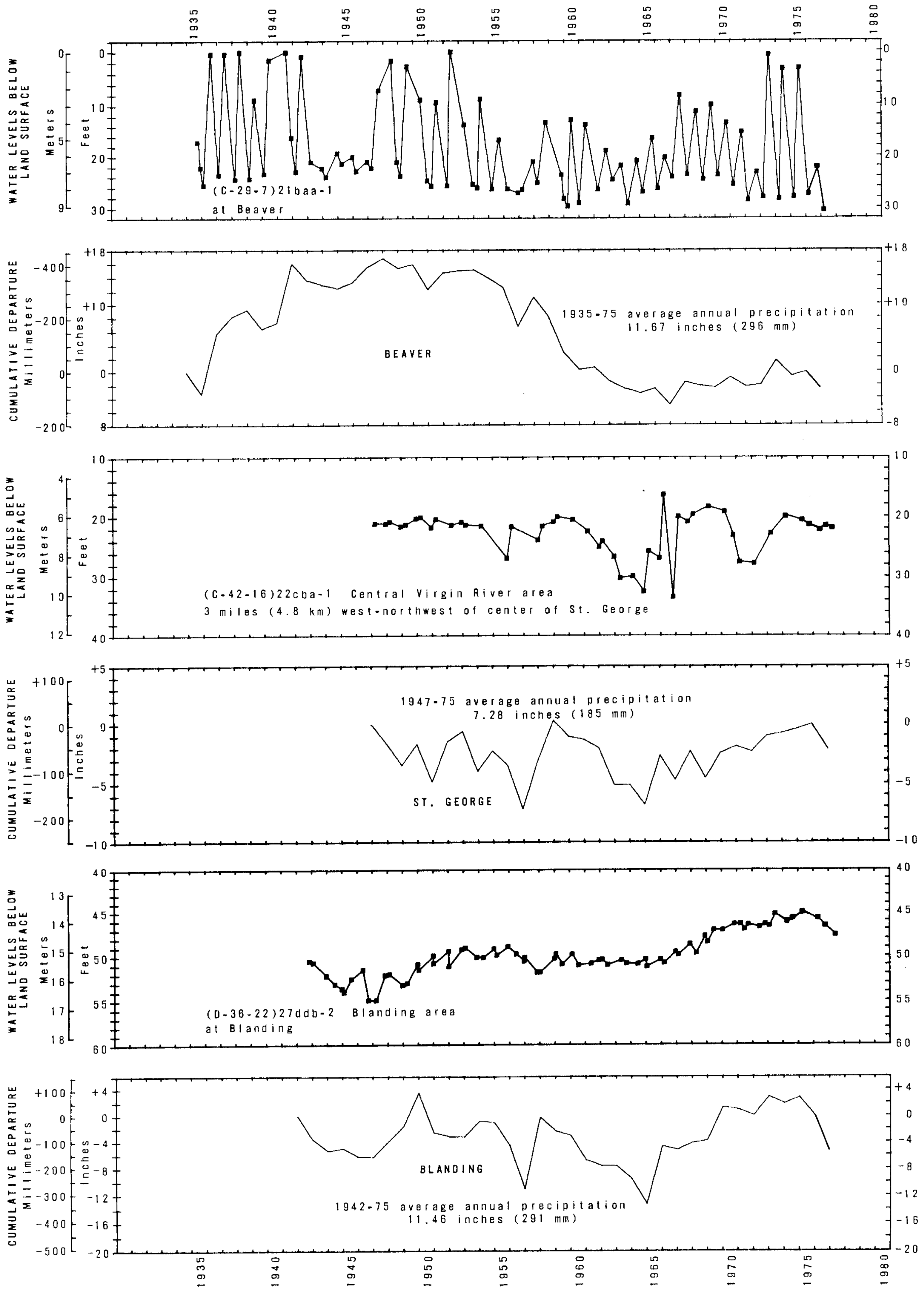

Figure 37.— Continued.

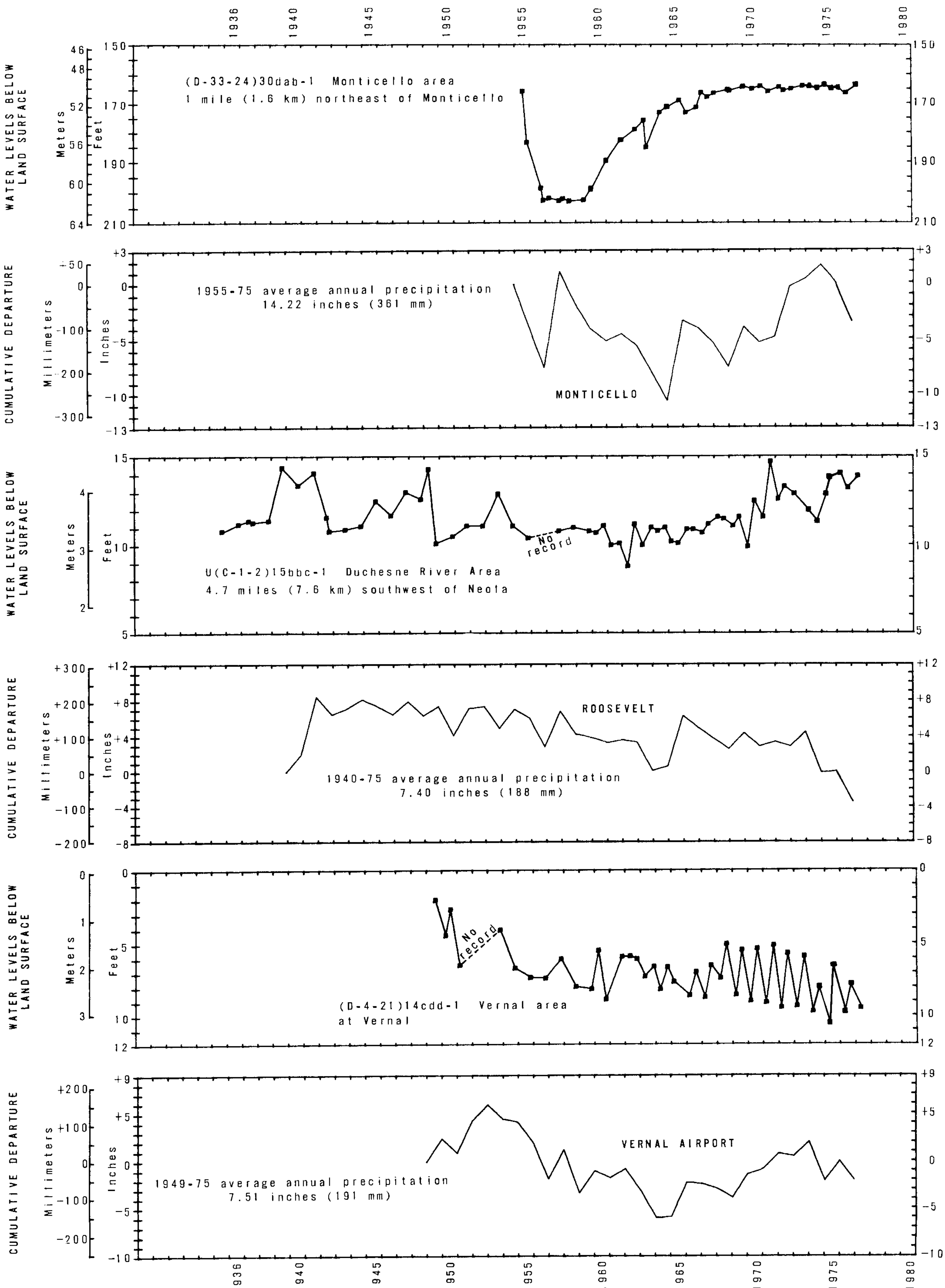

Figure 37.—Continued.